CONFIDENTIAL

Copy
RM L58C13

CASE FILE
COPY

NACA

RESEARCH MEMORANDUM

EFFECTS OF EXTERNAL STORE-PYLON CONFIGURATION AND POSITION ON THE AERODYNAMIC CHARACTERISTICS OF A 45° SWEPT WING-FUSELAGE COMBINATION AT A MACH NUMBER OF 1.61

By Odell A. Morris

Langley Aeronautical Laboratory
Langley Field, Va.

Classification Changed to Unclassified
Authority: NASA Technical Publications Announcements No. 33
Effective Date: October 28, 1960
WHL

CLASSIFIED DOCUMENT

This material contains information affecting the National Defense of the United States within the meaning of the espionage laws, Title 18, U.S.C., Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

NATIONAL ADVISORY COMMITTEE
FOR AERONAUTICS

WASHINGTON
May 13, 1958

CONFIDENTIAL

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

RESEARCH MEMORANDUM

EFFECTS OF EXTERNAL STORE-PYLON CONFIGURATION AND POSITION ON THE AERODYNAMIC CHARACTERISTICS OF A 45° SWEPT WING-FUSELAGE COMBINATION AT A MACH NUMBER OF 1.61

By Odell A. Morris

SUMMARY

An investigation on pylon-mounted-store airplane configurations has been conducted in the Langley 4- by 4-foot supersonic pressure tunnel at a Mach number of 1.61. The forces and moments on the complete wing-fuselage-store-pylon combination were measured for a number of pylon-mounted store locations below the wing. Tests were made through a wide angle-of-attack and sideslip range for each store-pylon configuration. The basic model configuration, which had a 45° sweptback wing, simulates a heavy bomber-type airplane (excluding tail assembly) with large ogive cylinder stores with and without fins and tail cones.

The results of the investigation indicate that the addition of store and pylon lowered the maximum lift-drag ratio of the wing-fuselage combination from 5.4 to around 4.6. Changes in maximum lift-drag ratio due to changing store-pylon position were small in all cases, being less than 4 percent of the maximum lift-drag ratio for the isolated wing-fuselage combination.

Variation in store-pylon spanwise and chordwise position produced significant incremental changes in the trim lift and the zero-lift pitching-moment coefficients; however, changes in the lift-curve slopes were generally negligible.

The addition of the store and pylon produced large increments in the side force of the wing-fuselage combination in sideslip for most of the positions tested. These large increments also resulted in significant changes in the directional stability of the wing-fuselage combination; however, the magnitude and direction of the changes were largely dependent upon store position.

INTRODUCTION

A number of investigations have been conducted by the National Advisory Committee for Aeronautics on wing-fuselage-store combinations aimed at supplying general information on store loads and the mutual interference effects between the various wing-fuselage and store components at supersonic speeds. (For examples, see refs. 1 to 4.) However, information on pylon loads and on the interference effects of the pylon on the wing and store is still somewhat limited.

An experimental investigation conducted in the Langley 4- by 4-foot supersonic pressure tunnel aimed at supplying such data is described in reference 5. This reference presents in detail that portion of the investigation pertaining to the forces and moments on the store, and on various store-pylon combinations in the presence of a wing and fuselage. The present report presents the results of the investigation, which include the forces and moments (six components), on the complete wing-fuselage-store-pylon combination. The wing-fuselage configuration simulates a swept-wing heavy bomber, whereas the store represents a large external store. The tests were conducted for a number of spanwise and chordwise positions with several different store-pylon combinations. Data were obtained over a wide angle-of-attack and sideslip range at a Mach number of 1.61.

SYMBOLS

C_L lift coefficient, $\frac{\text{Lift}}{qS}$

C_D drag coefficient, $\frac{\text{Drag}}{qS}$

C_m pitching-moment coefficient about $\bar{c}/4$, $\frac{\text{Pitching moment}}{qS\bar{c}}$

C_Y side-force coefficient, $\frac{\text{Side force}}{qS}$

C_n yawing-moment coefficient about $\bar{c}/4$, $\frac{\text{Yawing moment}}{qSb}$

C_l rolling-moment coefficient, $\frac{\text{Rolling moment}}{qSb}$

F_A	axial force, lb
F_N	normal force, lb
F_Y	side force, lb
M_X	rolling moment, in-lb
M_Y	pitching moment, in-lb
M_Z	yawing moment, in-lb
q	free-stream dynamic pressure, lb/sq ft
S	total wing area, sq ft
V	free-stream velocity, ft/sec
b	wing span, ft
$\bar{c}$	wing mean aerodynamic chord, ft
x	chordwise position of store midpoint measured from nose of fuselage, in.
y	spanwise position of store center line, measured from fuselage center line, in.
z	vertical height of store center line, measured from wing chord plane, in.
α	angle of attack, deg
β	angle of sideslip, deg
ΔC_D	incremental drag coefficient
L/D	lift-drag ratio, C_L/C_D
C_{L_α}	lift-curve slope at zero lift
$\frac{dC_m}{dC_L}$	rate of change of pitching-moment coefficient with lift coefficient

C_{m_o} pitching-moment coefficient at zero lift coefficient

$C_{L_{trim}}$ lift coefficient at zero pitching-moment coefficient

APPARATUS AND TESTS

Models and Equipment

The principal dimensions of the models and the general arrangement of the test setup are shown in figure 1. The 45° swept wing-fuselage-store combination was designed to simulate a heavy bomber-type airplane with a large external store. The dimensions of this configuration were identical to those of the semispan model used in references 1 and 2 except for the cylindrical afterbody on the present fuselage.

The wing and fuselage were constructed of steel, and were sting mounted with a six-component strain-gage balance enclosed within the fuselage. Pressure orifices were provided on the fuselage base for the measurement of base pressure. The stores were also constructed of metal and were supported by wing-mounted pylons under each wing panel. Slots were milled into the wing to provide a flat mounting surface for the pylons at each store position tested.

The stores and store-pylon combinations under each wing panel were also instrumented, and the details of the store-pylon installation together with the store data obtained have been reported in reference 5. The two different types of pylons used in the tests (a swept and an unswept pylon) had symmetrical 9-percent-thick circular-arc sections parallel to the free airstream and were designed to permit mounting in both a swept-forward position and a swept-rearward position. The 9-percent thickness of the pylon, though larger than desired, was necessary in order to permit use of a balance within the pylon which supplied data presented in reference 5.

Tests

The complete wing-store model combination was mounted on the standard rotary sting in the Langley 4- by 4-foot supersonic pressure tunnel, which allowed the model to be pitched or yawed through a wide range of positions. For each store position, tests were made through an angle-of-attack range of -4° to 12° ($\beta = 0°$) and through an angle-of-sideslip range of -4° to 12° at constant angles of attack of 0°, 4°, and 8°. However, for some positions, the angle ranges were restricted to the lower

angles by the load limits of the test equipment. The angles of attack and sideslip have been corrected for deflection of the balance and sting under load. Also drag corrections have been made using the measured base pressure drag.

The various store-pylon configurations tested are shown in figure 2(a); figure 2(b) shows the positive direction of the measured forces and moments. For all model configurations tested, symmetrical store locations about the fuselage center line were employed. For all tests, in order to insure a turbulent boundary layer, a 1/4-inch-wide strip of No. 60 carborundum grains and shellac was located on both surfaces of the wing at the 10-percent-chord point, on the fuselage nose 1/2 inch from the tip, and on the store nose 1/4 inch from the tip.

The tests were conducted in the Langley 4- by 4-foot supersonic pressure tunnel at a Mach number of 1.61 with a stagnation pressure of 5 pounds per square inch absolute and a corresponding Reynolds number of 1.4×10^6 per foot. Also, repeat tests were conducted at a stagnation pressure of 10 pounds per square inch absolute with a corresponding Reynolds number of 2.7×10^6 per foot. Comparison of the data taken at both pressures showed good agreement. (See fig. 3.)

Accuracy of Data

An estimate of the probable errors introduced in the present data as determined from an inspection of repeat test points and static-deflection calibration is as follows:

C_D	±0.001
C_L	±0.010
C_m	±0.002
C_Y	±0.002
C_n	±0.001
C_l	±0.001
α, deg	±0.2
β, deg	±0.2
x, in.	±0.025
y, in.	±0.050
z, in.	±0.025

PRESENTATION OF DATA

The longitudinal coefficients are plotted against angle of attack and the lateral coefficients are plotted against angle of sideslip for the various store positions tested and are presented in figures 4 to 17. The figures are plotted with the data for two, three, or four store positions in each figure with the store-pylon configuration used being identified by the symbol opposite the small-scale drawing in each figure. The fifteen model combinations tested are grouped in such a manner as to show the various effects of the different store-pylon positions and combinations, and thus in a number of the figures some of the data are repeated for ease of comparison.

In figure 18, the longitudinal aerodynamic characteristics of the model combination are plotted for the basic spanwise and chordwise store position. The incremental drag coefficients due to the addition of the stores are plotted against lift coefficient in figure 19 and the lift-drag ratios are plotted against the lift coefficient in figure 20. Figures 21 and 22 are plots which show the relative contribution of the store-pylon drag and side force toward the total load at $\alpha = 0^{\circ}$. Schlieren photographs of several of these model configurations which were obtained during the tests have been presented in reference 5, and therefore were not repeated herein.

RESULTS AND DISCUSSION

Effect of Store Position on the Aerodynamic Characteristics in Pitch

In general, for most test positions of the basic store, large changes in the lift, drag, and pitching-moment coefficients were produced by the addition of the store-pylon combination. (See figs. 4, 5, and 6.) The increment in drag due to the addition of the basic store-pylon combination for all test positions was considerably larger at low lift coefficients than at high lift coefficients.

The summary plot of the longitudinal characteristics for the spanwise and chordwise store positions (figs. 18 and 19) shows more clearly the effects of the store and pylon presence on lift, drag, and pitching moment. The data of figure 18 show that the addition of the basic store and pylon produced negligible changes in the lift-curve slopes C_{L_α} with variation in the spanwise and chordwise store positions. However,

the slope of the pitching-moment curves $\frac{dC_m}{dC_L}$ shows that the addition of the stores decreased the stability of the wing-fuselage combination for all positions except for the sweptback pylon-store position ($y = 6.6$ inches, $x = 28.9$ inches). The plot of $C_{L_{trim}}$ and C_{m_o} show that favorable increases in $C_{L_{trim}}$ and C_{m_o} were obtained for all store positions except for the outboard spanwise position and for the rearward chordwise position with the sweptback pylon. The positive values of $C_{L_{trim}}$ indicate that some decrease in drag due to control-surface trimming can be expected with these store positions. The store positions producing negative increments in $C_{L_{trim}}$, on the other hand, will incur an increase in drag due to trimming. The data presented are for the model with no horizontal tail; consequently, the interference of the store and pylon on a horizontal tail will influence the net results for the complete configuration.

The data of figure 20 show that addition of the store to the wing-fuselage combination decreased the maximum L/D values between 13 and 16.5 percent, depending on store position. Thus, the change in maximum L/D due to store position is less than 4 percent. These results are similar to those of reference 6. The data of reference 6 for a similar model configuration show a 4.3-percent change in maximum L/D values due to variation in store position. This small percentage change due to store position results partly from the fact that some of the store positions which produced favorable decreases in drag also produce unfavorable decreases in lift. In addition, the data of reference 1 have previously shown that at low angles of attack, large store vertical heights such as used in the present tests produce considerably less change in drag with variation in store position than corresponding small store vertical heights. For the basic store positions tested, the sweptback store-pylon combination ($x = 28.9$ inches, $y = 6.6$ inches) produced the maximum L/D values throughout the angle-of-attack range. The incremental drag plot of figure 19 shows that the sweptback store-pylon combination also has the lowest drag coefficient at $C_L = 0$ of the stores tested. However, when considering the trim conditions for a complete airplane configuration, the adverse negative $C_{L_{trim}}$ values produced by the sweptback store-pylon combination (fig. 18) would tend to counteract the slight favorable advantage obtained for the L/D and low C_D values.

Effect of Store Position on the Aerodynamic Characteristics in Sideslip

Addition of the store and pylon is shown in figures 11, 12, and 13 to increase (negatively) the side force by a large amount at positive angles of sideslip. Hereafter, all discussion of the lateral characteristics will refer to the absolute magnitude of the coefficients at positive angles of sideslip. The increments due to the addition of the store and pylon to the wing-fuselage combination are in general equal to or greater than the side force of the wing-fuselage alone. The largest increments are found for the farthest outboard store position (fig. 11) and for the chordwise positions where the pylon lies within the high sidewash field directly beneath the wing (fig. 12).

The yawing-moment data (figs. 11 to 13) show large changes in yawing-moment coefficient due to addition of store and pylon. The more forward positions yield destabilizing moments (fig. 11), whereas the more rearward positions in some cases contribute large stabilizing moments (figs. 11 and 12) to the negative directional stability of the wing-fuselage combination.

Large increments in rolling moments are also produced by certain store-pylon combinations (figs. 11 to 13). The amount and direction of the incremental rolling moments varies with store position. The effect of the store-pylon combination on rolling moment is complex, being the result of direct forces on the store and pylon, effects of store and pylon on wing pressures, and the effects of store and pylon on wing-fuselage interference. For all of the lateral coefficients, the data for the combined angles of attack and sideslip show that the magnitude of the coefficients is not greatly affected by an increase in angle of attack.

Store Fins and Store Tail Cone

The data of figures 7, 8, 14, and 15 show that the addition of the faired tail cone to the basic store produced no large effects on any of the measured lateral or longitudinal coefficients. In general, the addition of the store fins caused only small changes in drag with increasing lift coefficients whereas somewhat larger changes were noted to occur for the pitching-moment coefficients for some store positions. (See figs. 6 to 9.) The angle-of-sideslip data of figures 13 to 16 show that the fins, in general, slightly increased (negatively) the side-force coefficient with increases in β and incurred small to moderate changes (tending to stabilize) in the yawing-moment coefficients.

Double-Store Installation

The addition of a second store-pylon combination on the same wing panel (see fig. 2) caused an increase in configuration drag at low angles approximately twice that incurred with one store (fig. 9). The magnitude of the side force measured in sideslip was similarly increased (negatively). (See fig. 16.) Also, for the double-store configuration, a decrease in the maximum L/D was noted (fig. 20) which was 0.30 less than the maximum L/D obtained for the single inboard store ($x = 21.9$ inches, $y = 6.6$ inches), whereas a decrease of 0.45 was noted when compared with the single outboard store ($x = 26.4$ inches, $y = 10.2$ inches).

Effect of Pylon Location

Movement of the pylon position while maintaining a constant store location (fig. 10) showed only small effects on lift and drag. However, a slight shift in the pitching-moment curve occurred for a rearward movement of the pylon. The data of figure 17 show that the rearward pylon movement caused a small decrease in the side force and also produced small increases (negatively) in the rolling moment due to sideslip.

Relative Contribution of Store-Pylon Forces Toward Total Force

In order to show the relative contribution of the store and store-pylon drag and side force toward the complete configuration forces, the comparison plots of figures 21 and 22 were prepared with the use of the data of references 1 and 5 and the present wing-fuselage data. Figure 21 shows that the presence of the pylon produced sizeable incremental drag increases, approximately 30 to 100 percent (depending upon store position) of the drag increments produced by the store in the presence of the wing-fuselage combination. However, for most store positions shown, the incremental drag produced by the store was considerably larger than the drag increment produced by the pylon.

Figure 21 also shows that the drag decrease due to increasing the vertical height between store and wing is smaller than the drag of the required supporting pylon. This comparison suggests that, in the present case, no advantage in drag is gained by the use of long pylons. It should be pointed out, however, that the drag of the pylon in the present tests is higher than necessary because of the excessive thickness of the pylon (due to the internal strain-gage balance). In any case, though, it appears from these data that it may be difficult to realize a significant drag decrease from store positions having smaller interferences at greater vertical displacements from the wing.

The data of figure 22 show the relative contribution of the store and store-pylon side force toward the total side force with variation in angle of sideslip. This figure shows that the side-force load for complete wing-fuselage-store-pylon combination is larger than the side force of the wing-fuselage alone. However, addition of the measured store-pylon side force from reference 5 (in presence of wing-fuselage) and the side force of the isolated wing-fuselage gives a greater value of C_Y for the complete configuration than the measured total wing-fuselage-store-pylon side-force coefficient - by about 25 percent at the inboard store position and by about 12 percent for the outboard store position at an angle of sideslip of 12°. This result indicates that the interference of the store and pylon on the wing-fuselage is in a direction to reduce the side-force coefficient of the wing-fuselage when the store-pylon combination is present.

CONCLUSIONS

Forces and moments have been measured at a Mach number of 1.61 on a wing-fuselage-store-pylon combination for a number of store positions. Results of the investigation indicate the following conclusions:

1. The addition of store and pylon lowered the maximum lift-drag ratio of the wing-fuselage combination from 5.4 to around 4.6. Changes in maximum lift-drag ratio due to changing store-pylon position were small in all cases, being less than 4 percent of the maximum lift-drag ratio for the isolated wing-fuselage combination.

2. Variation in store-pylon spanwise and chordwise position produced significant incremental changes in the trim lift and the zero-lift pitching-moment coefficients; however, changes in the lift-curve slopes were generally negligible.

3. The addition of the store and pylon produced large increments in the side force of the wing-fuselage combination in sideslip for most of the positions tested. These large increments also resulted in significant changes in the directional stability of the wing-fuselage combination; however, the magnitude and direction of the changes were largely dependent upon store position.

Langley Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., February 25, 1958.

REFERENCES

1. Smith, Norman F., and Carlson, Harry W.: The Origin and Distribution of Supersonic Store Interference From Measurement of Individual Forces on Several Wing-Fuselage-Store Configurations. I.- Swept-Wing Heavy-Bomber Configuration With Large Store (Nacelle). Lift and Drag; Mach Number, 1.61. NACA RM L55A13a, 1955.

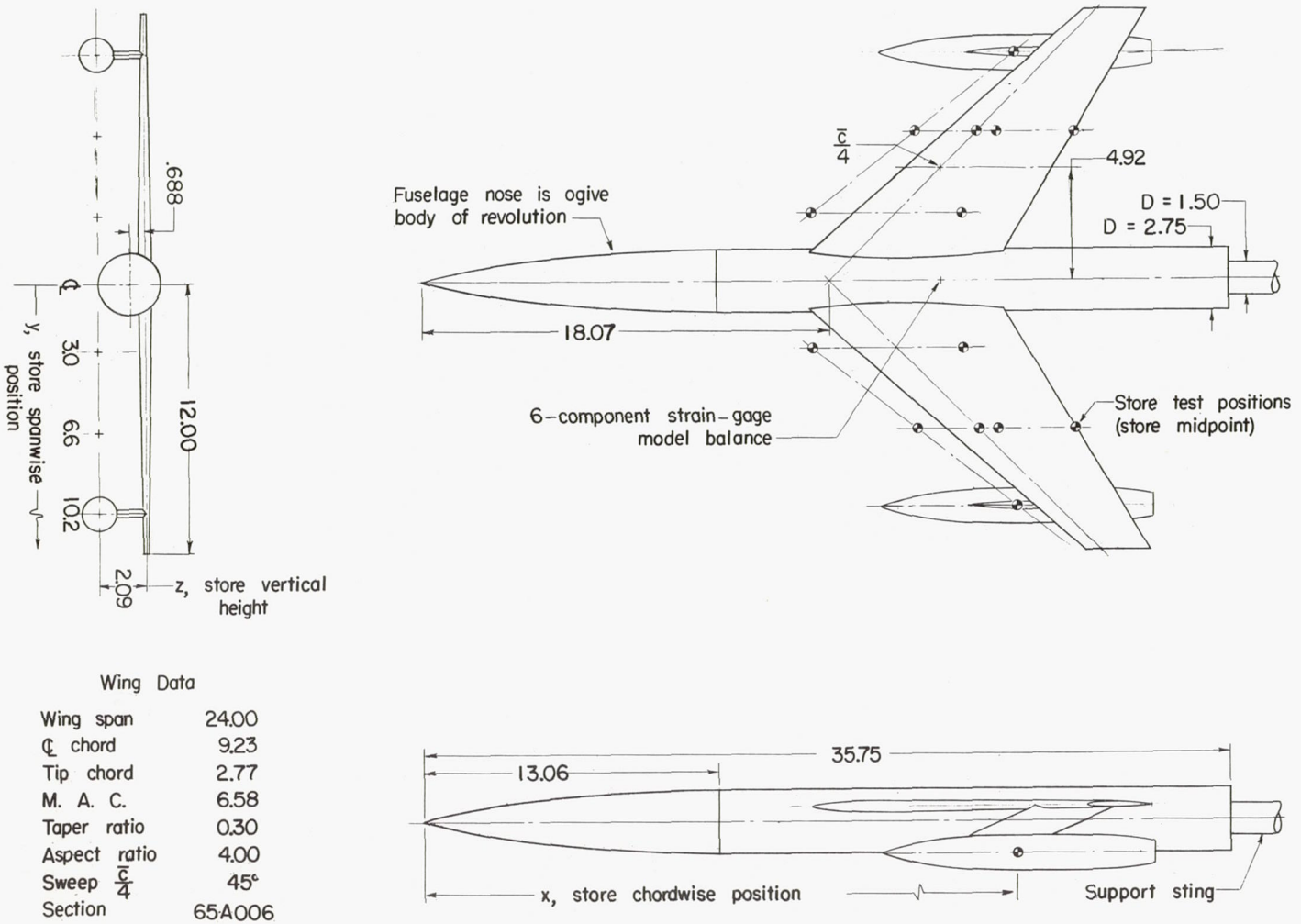
2. Smith, Norman F., and Carlson, Harry W.: The Origin and Distribution of Supersonic Store Interference From Measurement of Individual Forces on Several Wing-Fuselage-Store Configurations. II.- Swept-Wing Heavy-Bomber Configuration With Large Store (Nacelle). Lateral Forces and Pitching Moments; Mach Number, 1.61. NACA RM L55E26a, 1955.

3. Guy, Lawrence D., and Hadaway, William M.: Aerodynamic Loads on an External Store Adjacent to a 45° Sweptback Wing at Mach Numbers From 0.70 to 1.96, Including an Evaluation of Techniques Used. NACA RM L55H12, 1955.

4. Pearson, Albin O.: Transonic Investigation of Effects of Spanwise and Chordwise External Store Location and Body Contouring on Aerodynamic Characteristics of 45° Sweptback Wing-Body Configurations. NACA RM L57G17, 1957.

5. Morris, Odell A., Carlson, Harry W., and Geier, Douglas J.: Experimental and Theoretical Determination of Forces and Moments on a Store and on a Store-Pylon Combination Mounted on a 45° Swept-Wing—Fuselage Configuration at a Mach Number of 1.61. NACA RM L57K18, 1958.

6. Jacobsen, Carl R.: Effects of the Spanwise, Chordwise, and Vertical Location of an External Store on the Aerodynamic Characteristics of a 45° Sweptback Tapered Wing of Aspect Ratio 4 at Mach Numbers 1.41, 1.62, and 1.96. NACA RM L52J27, 1953.

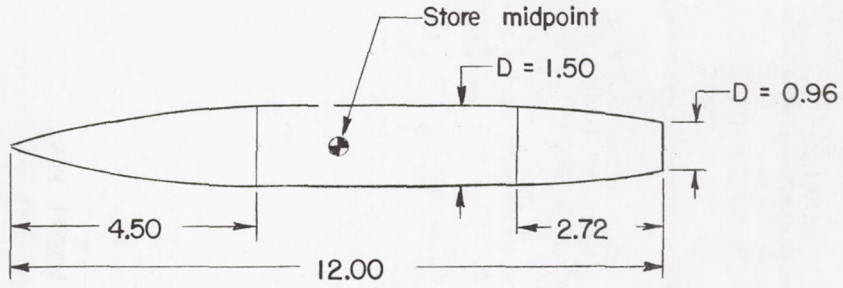


Wing Data

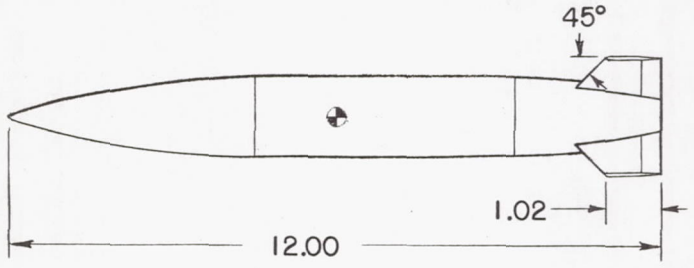
Wing span	24.00
℄ chord	9.23
Tip chord	2.77
M. A. C.	6.58
Taper ratio	0.30
Aspect ratio	4.00
Sweep $\frac{c}{4}$	45°
Section	65A006

(a) Dimensions of wing-fuselage model combination and store positions investigated.

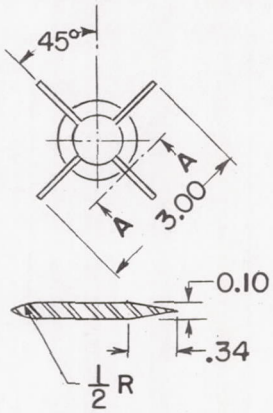
Figure 1.- Details of model and stores. (All dimensions in inches.)



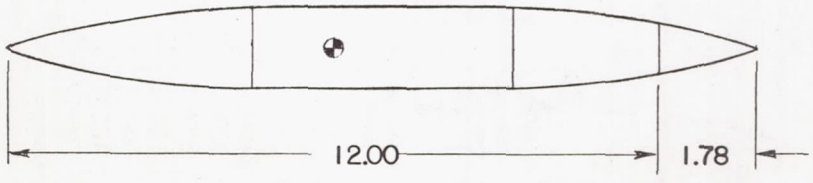
Basic store configuration



Basic store with fins added



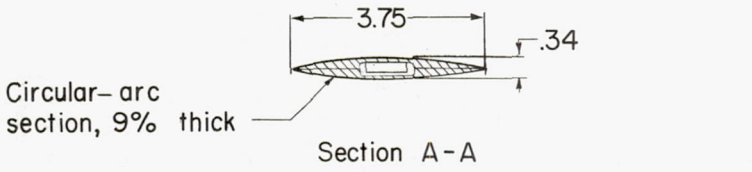
Section A-A, typ.

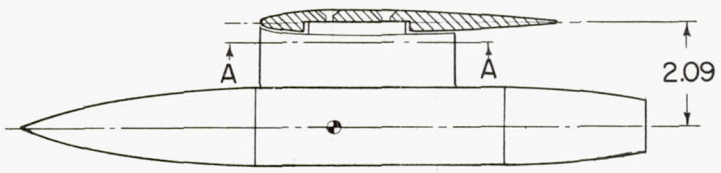


Basic store with tail cone added

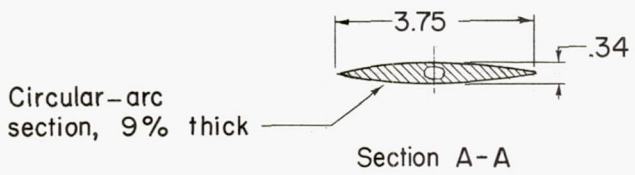
(b) Dimensions of store configurations tested. (Store nose and afterbody are ogive bodies of revolution. Center section is cylindrical.)

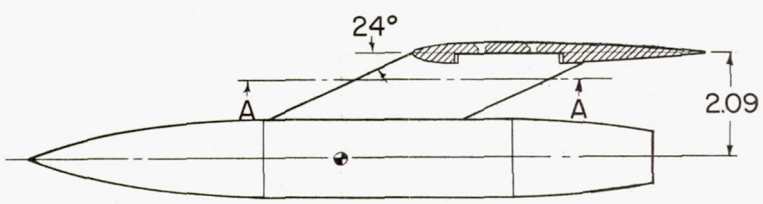
Figure 1.- Continued.





Unswept pylon-store
installation

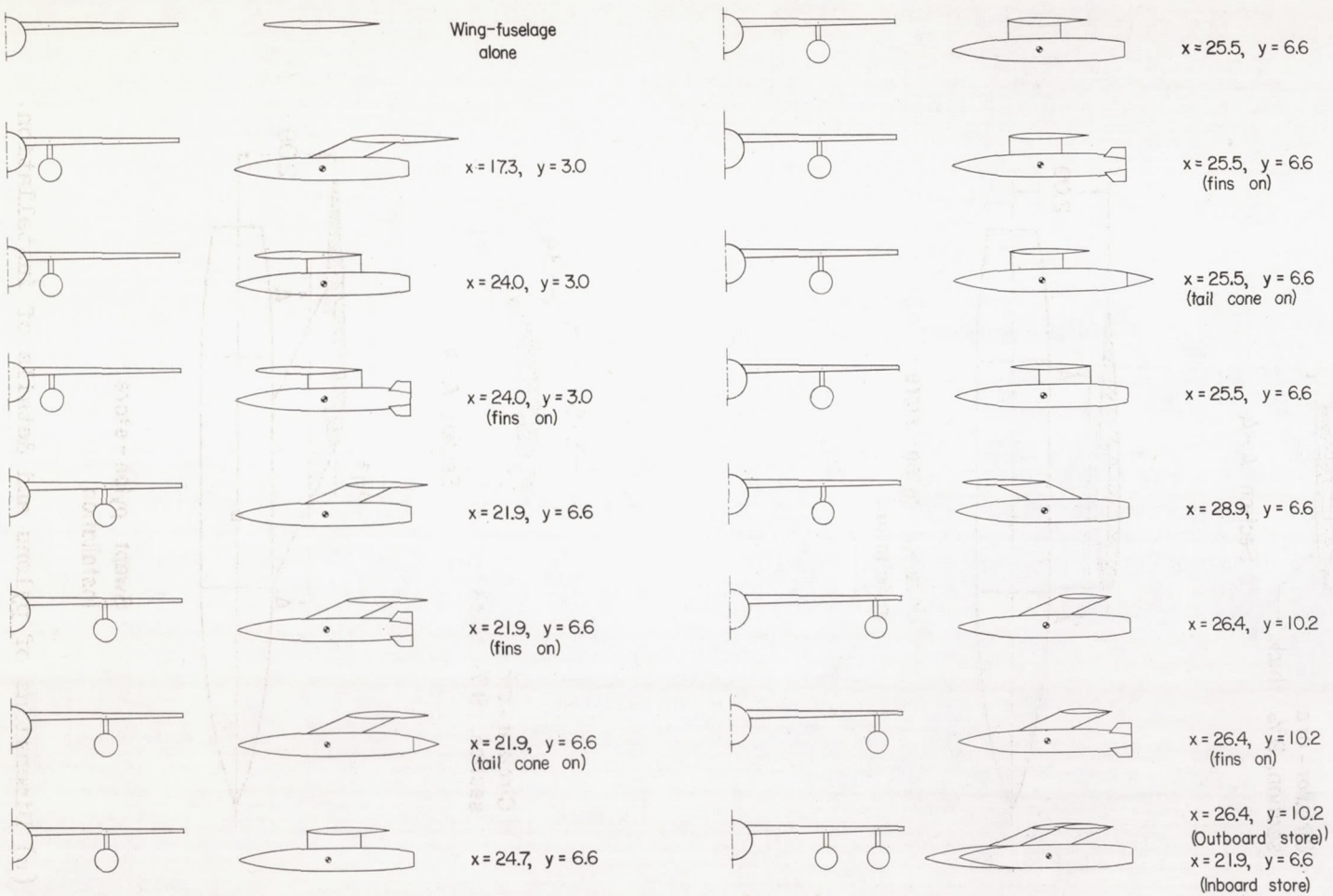




Swept pylon-store
installation

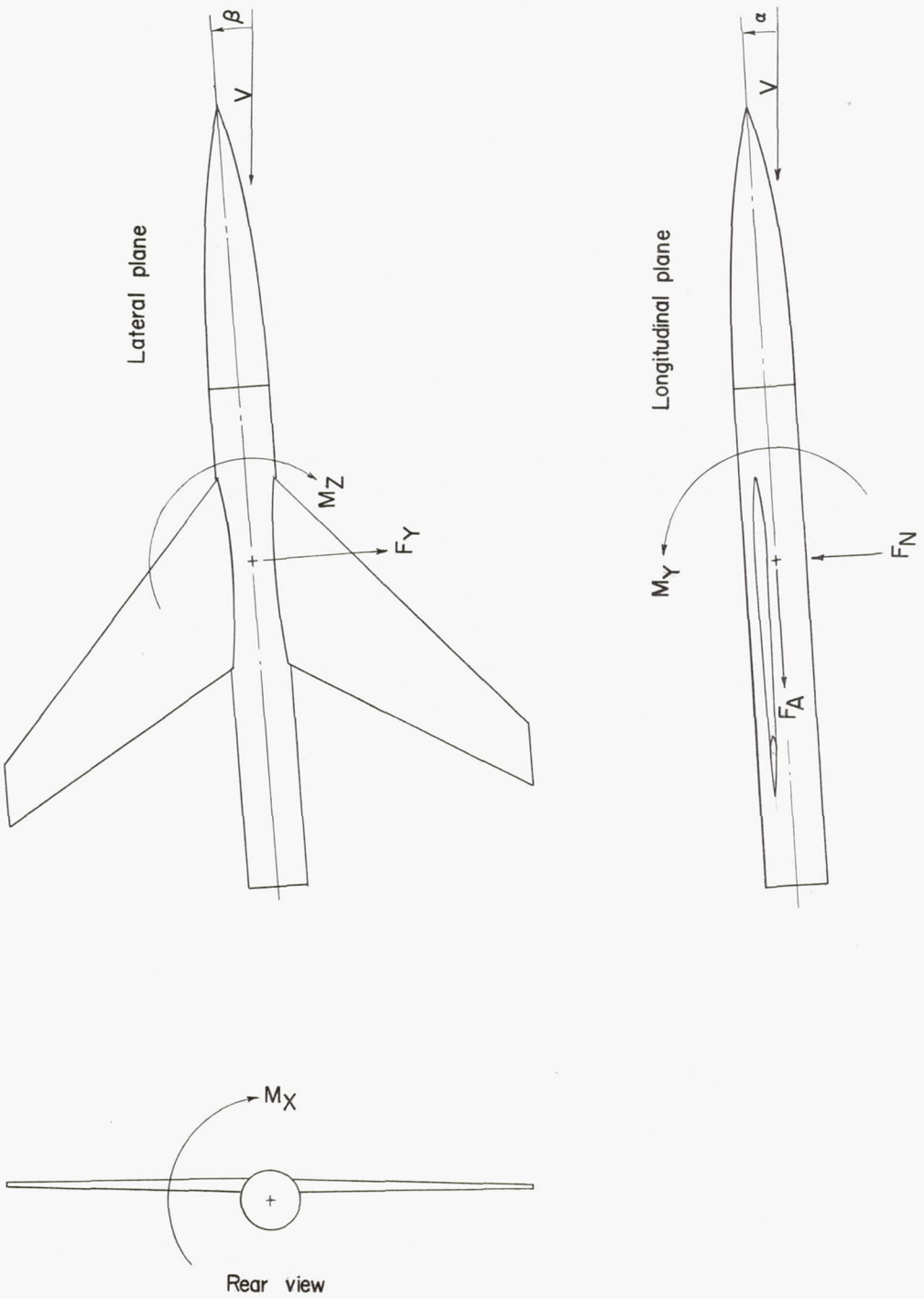
(c) Dimensions of pylons and details of installation.

Figure 1.- Concluded.



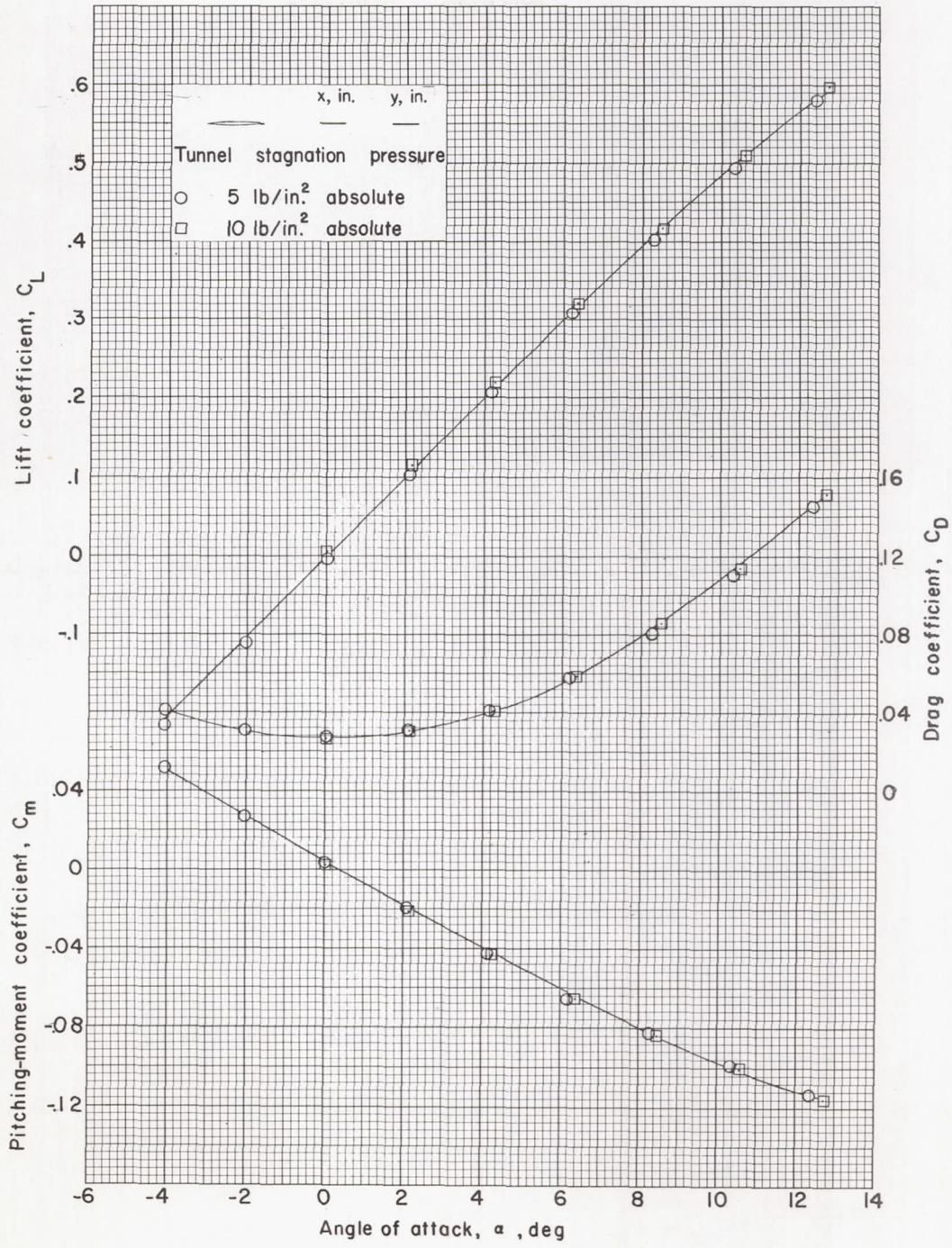
(a) Wing-fuselage-store-pylon configurations tested. (x and y given in inches.)

Figure 2.- Details of model configurations and direction of measured loads.



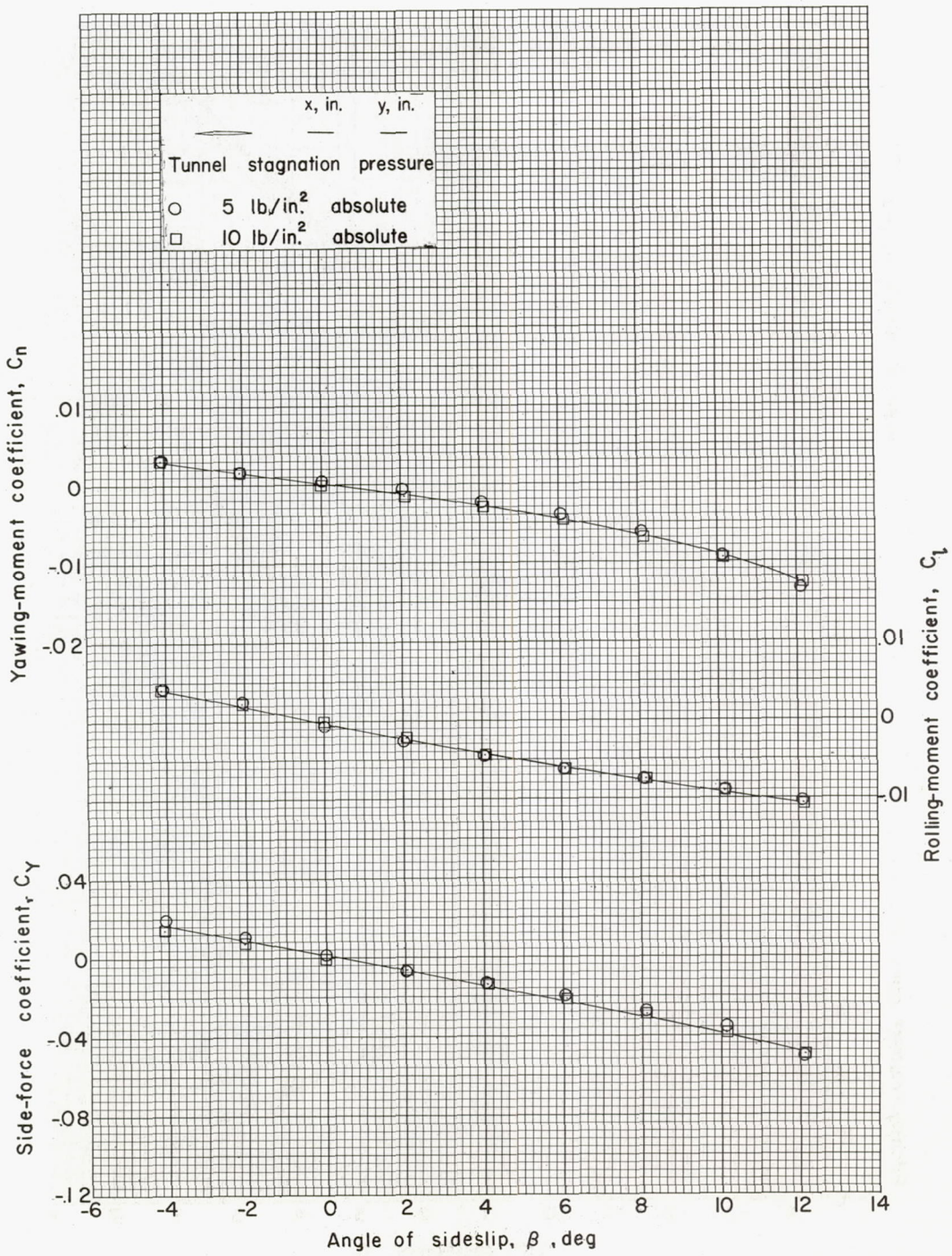
(b) Positive direction of forces and moments on the wing-fuselage combination.

Figure 2.- Concluded.



(a) Longitudinal coefficients.

Figure 3.- Effect of tunnel stagnation pressure on the aerodynamic characteristics of the wing-fuselage combination.



(b) Lateral coefficients.

Figure 3.- Concluded.

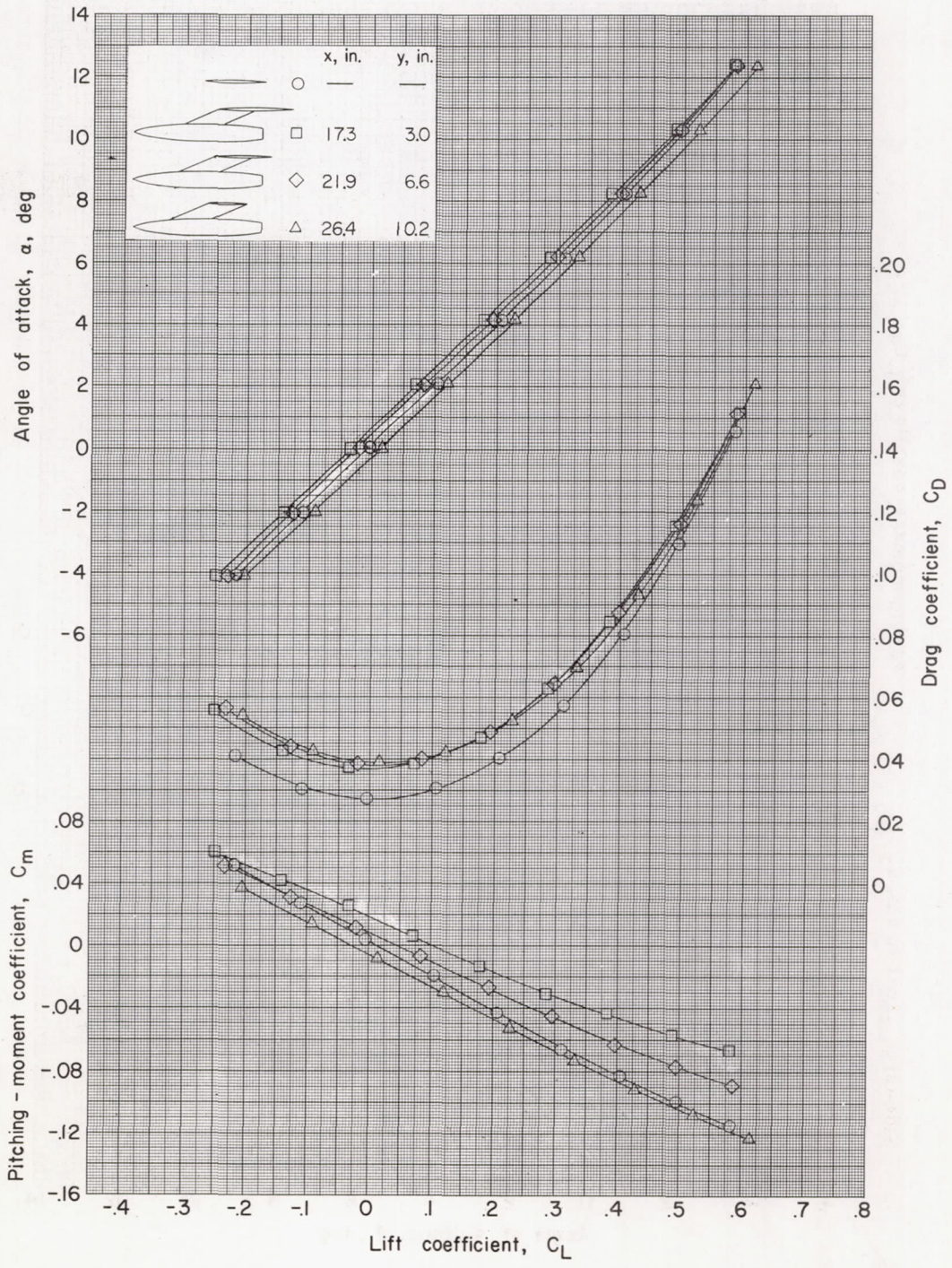


Figure 4.- Longitudinal characteristics of the wing-fuselage-store-pylon combination for three spanwise store positions. $\beta = 0^\circ$.

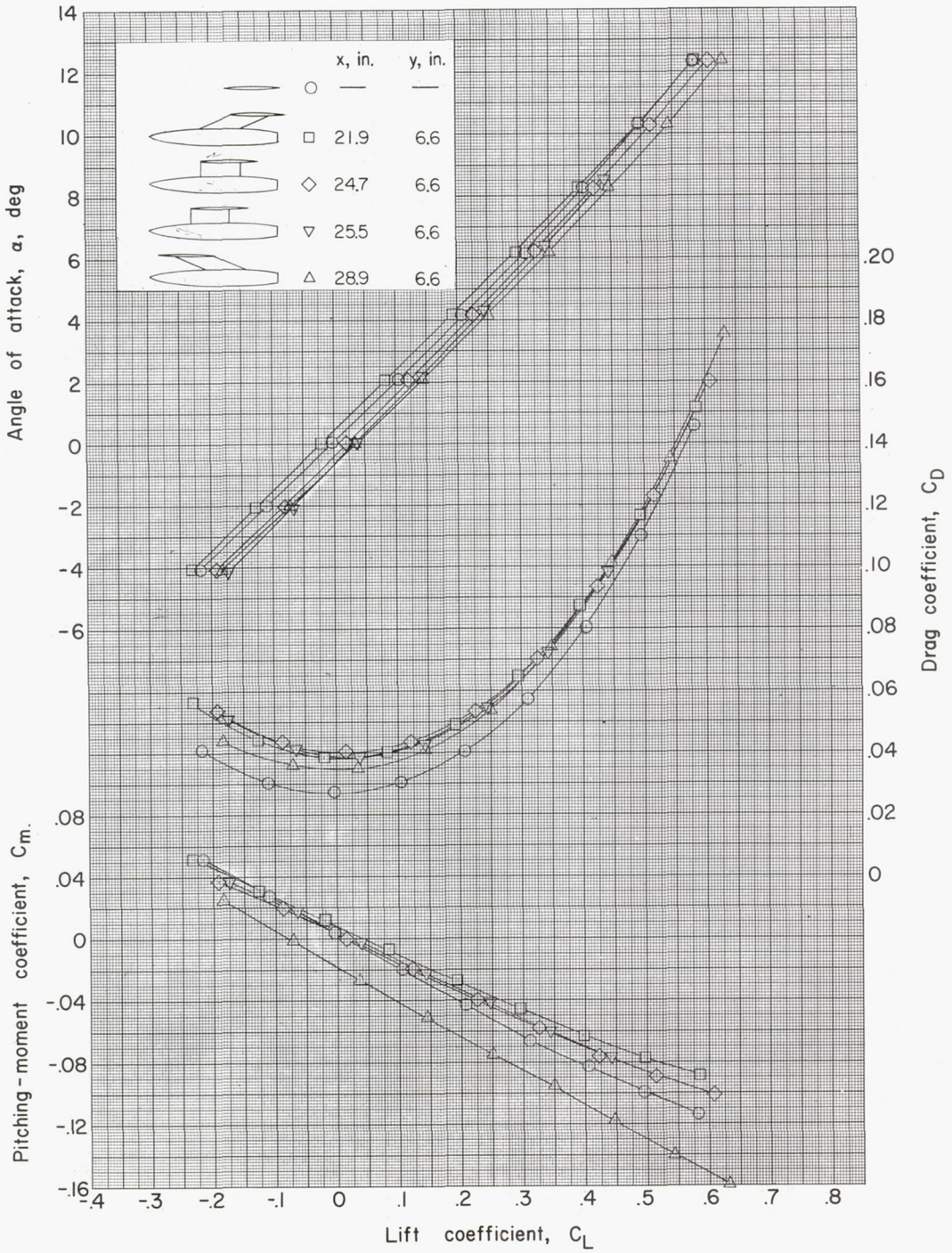


Figure 5.- Longitudinal characteristics of the wing-fuselage-store-pylon combination for four chordwise store positions. $\beta = 0^\circ$.

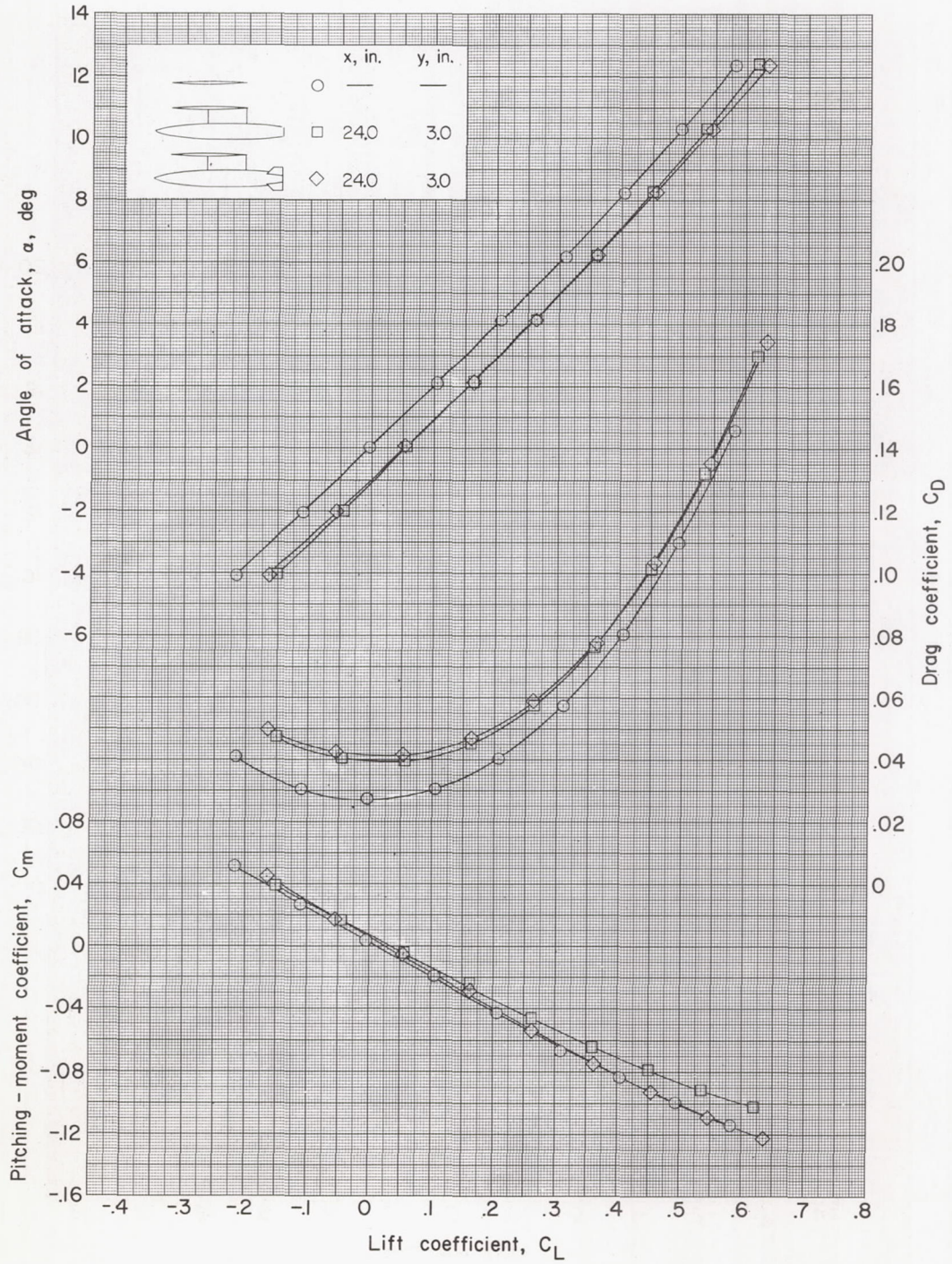


Figure 6.- Longitudinal characteristics of the wing-fuselage-store-pylon combination with store fins. $\beta = 0^\circ$.

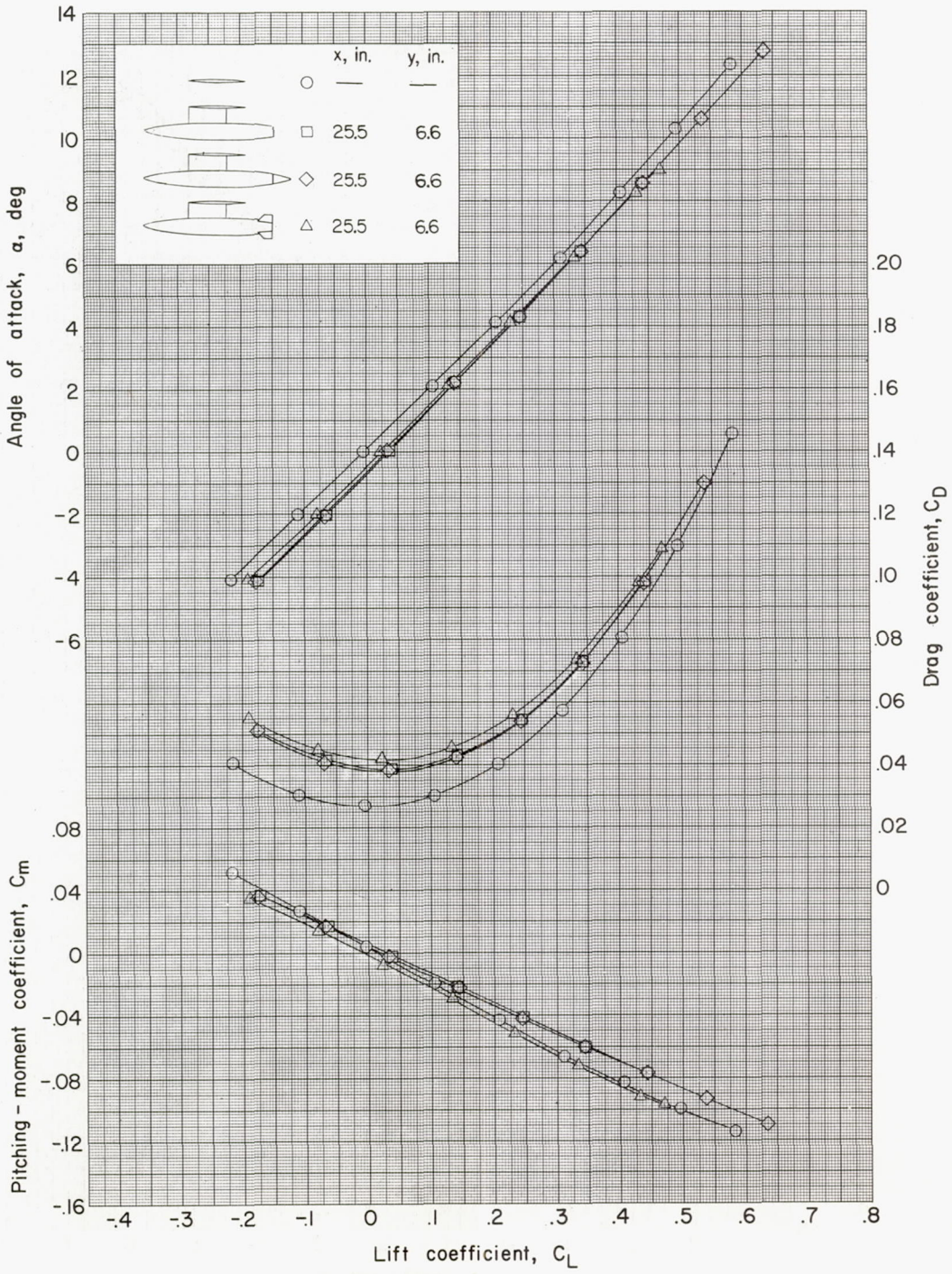


Figure 7.- Longitudinal characteristics of the wing-fuselage-store-pylon combination with store fins and with store tail cone. $\beta = 0^{\circ}$.

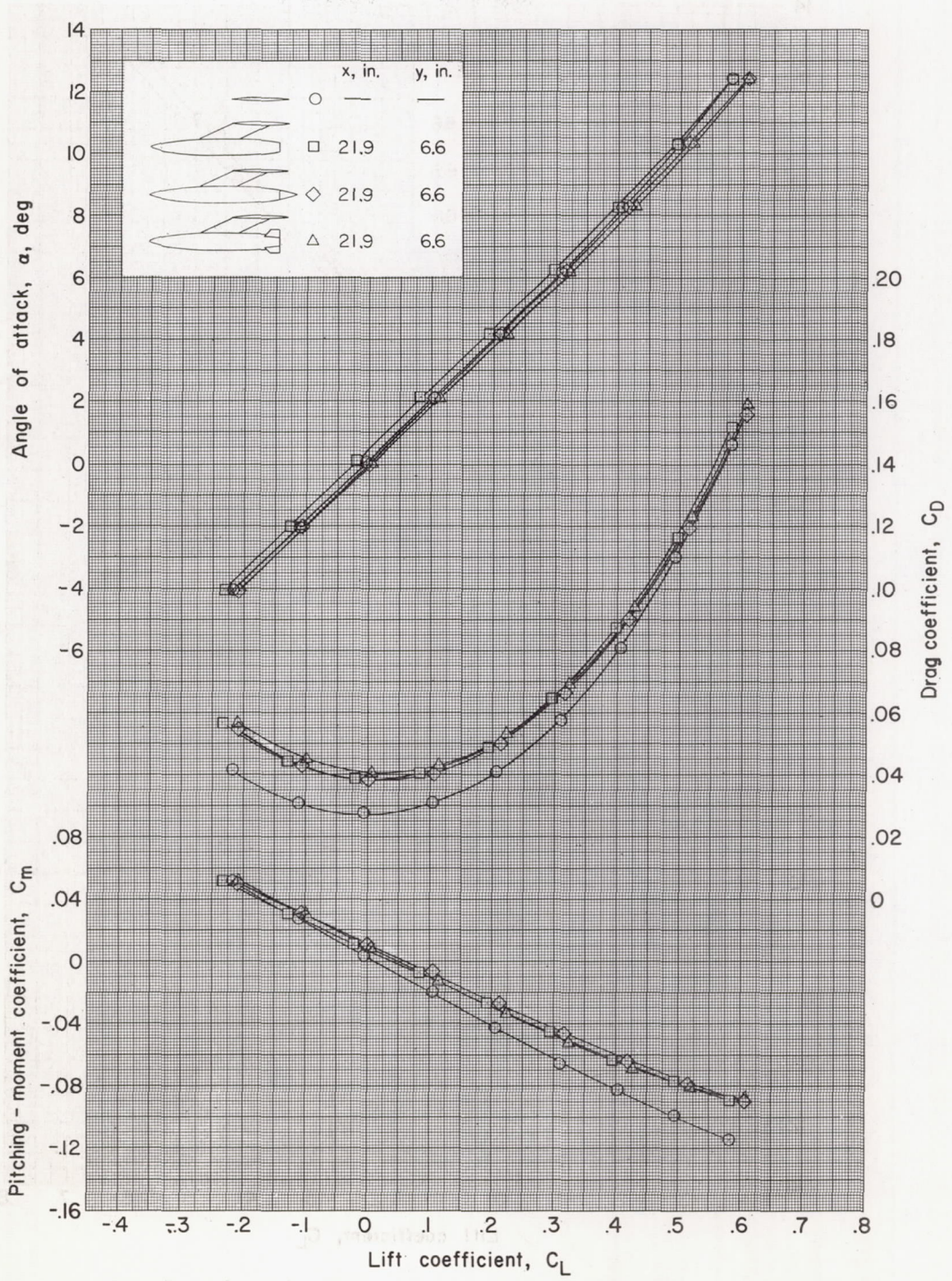


Figure 8.- Longitudinal characteristics of the wing-fuselage-store-pylon combination with store fins and with store tail cone. $\beta = 0^{\circ}$.

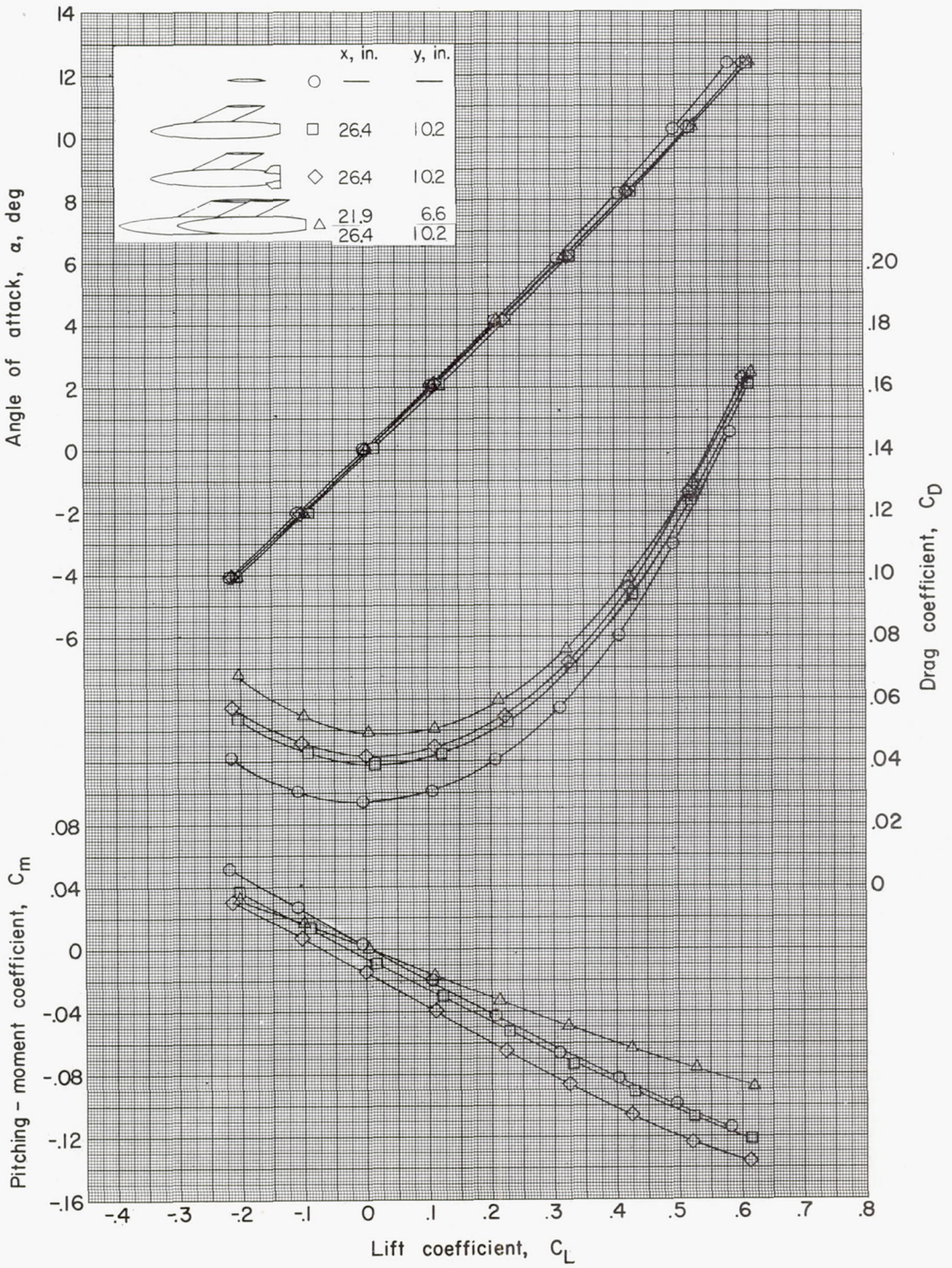


Figure 9.- Longitudinal characteristics of the wing-fuselage-store-pylon combination with store fins and with double-store installation. $\beta = 0^\circ$.

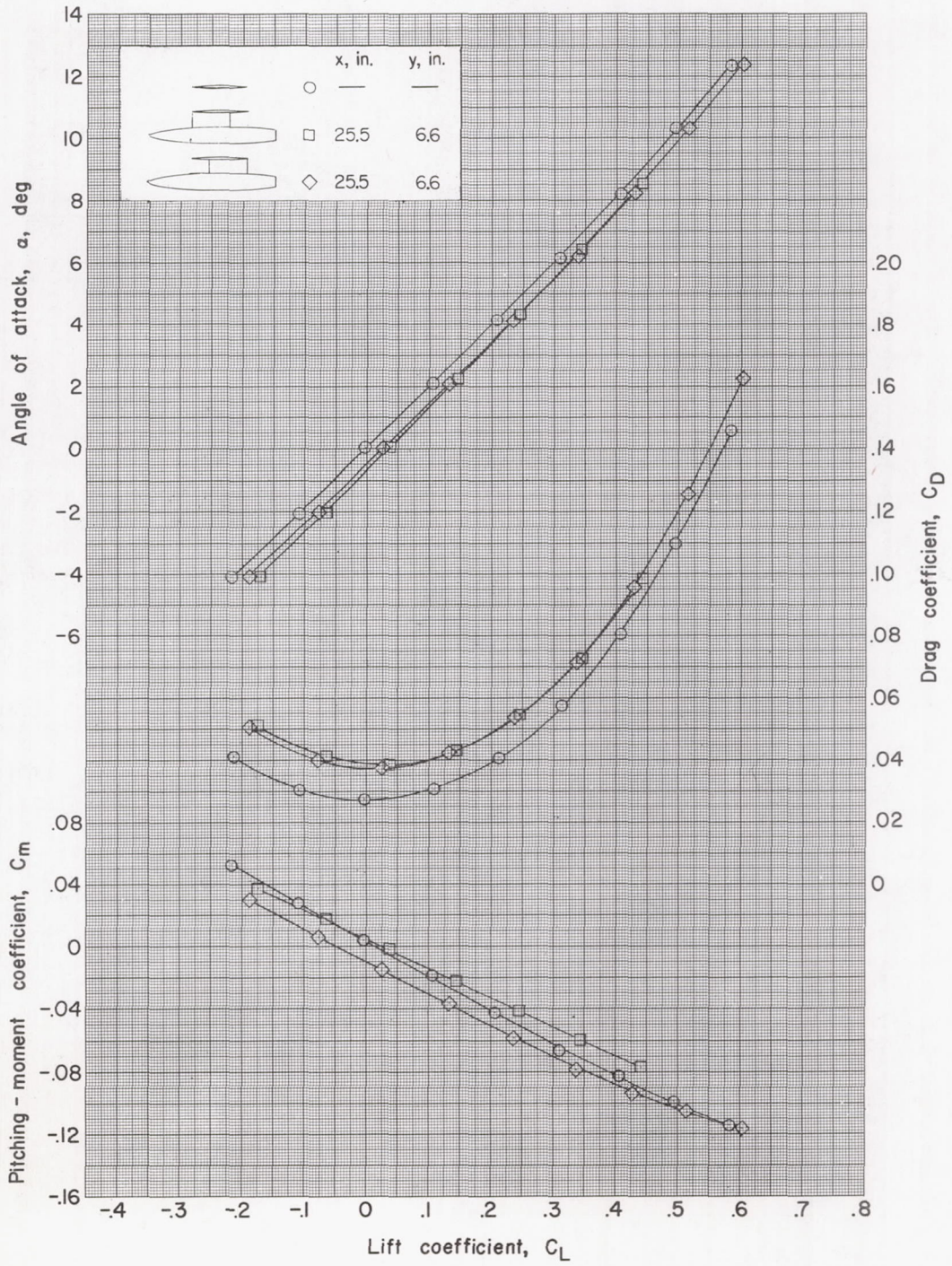
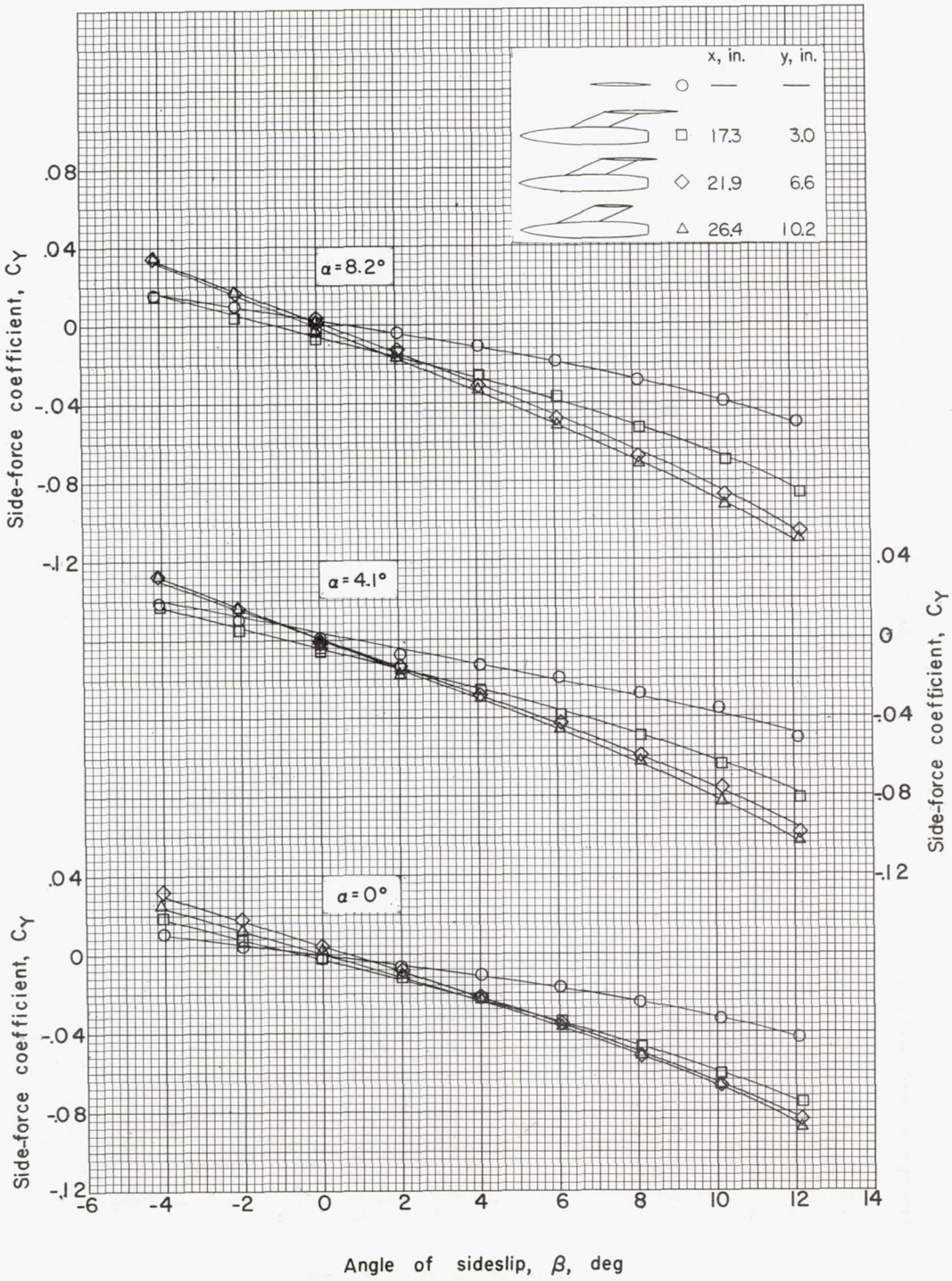
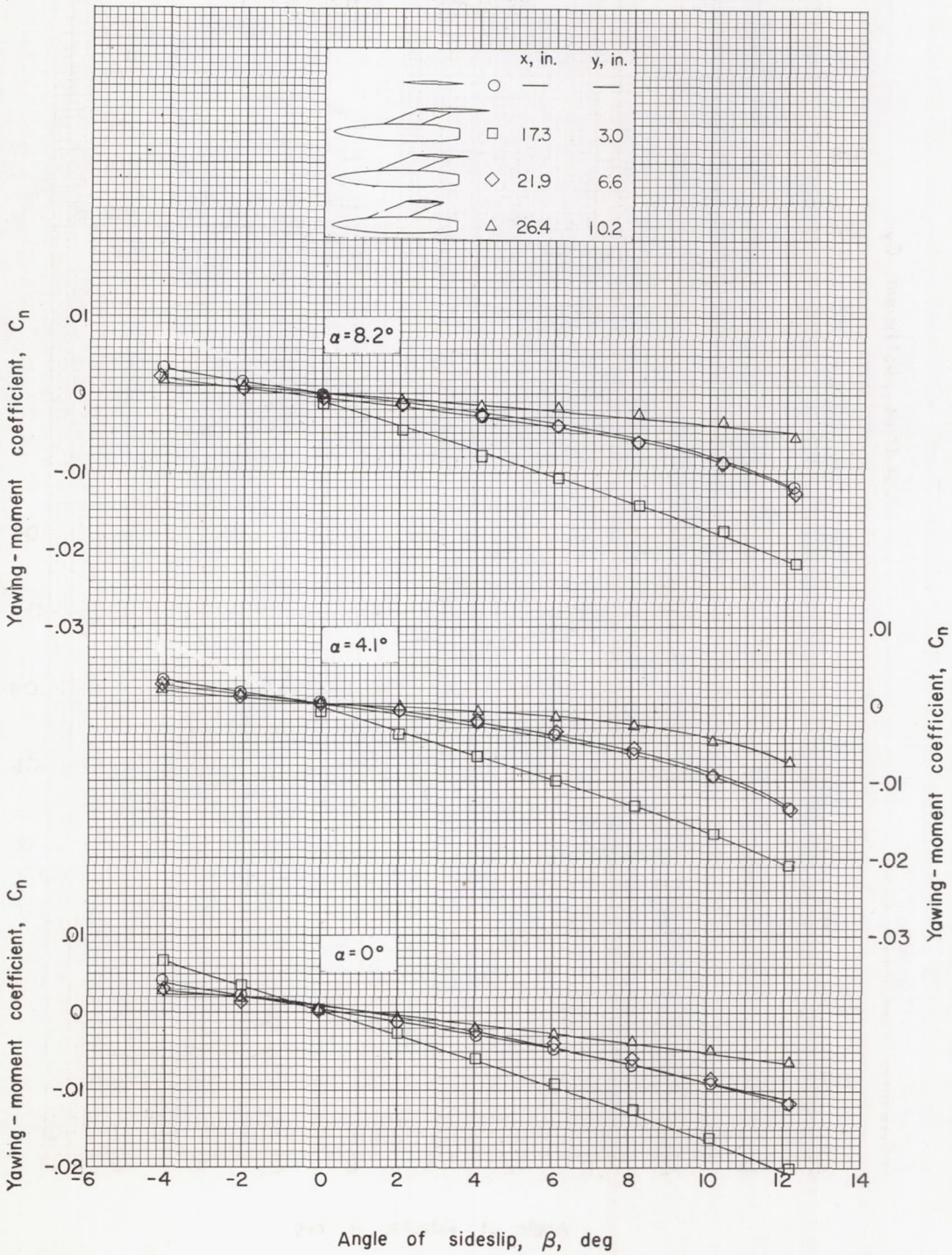


Figure 10.- Longitudinal characteristics of the wing-fuselage-store-pylon combination for a forward and rearward pylon location. $\beta = 0^{\circ}$.



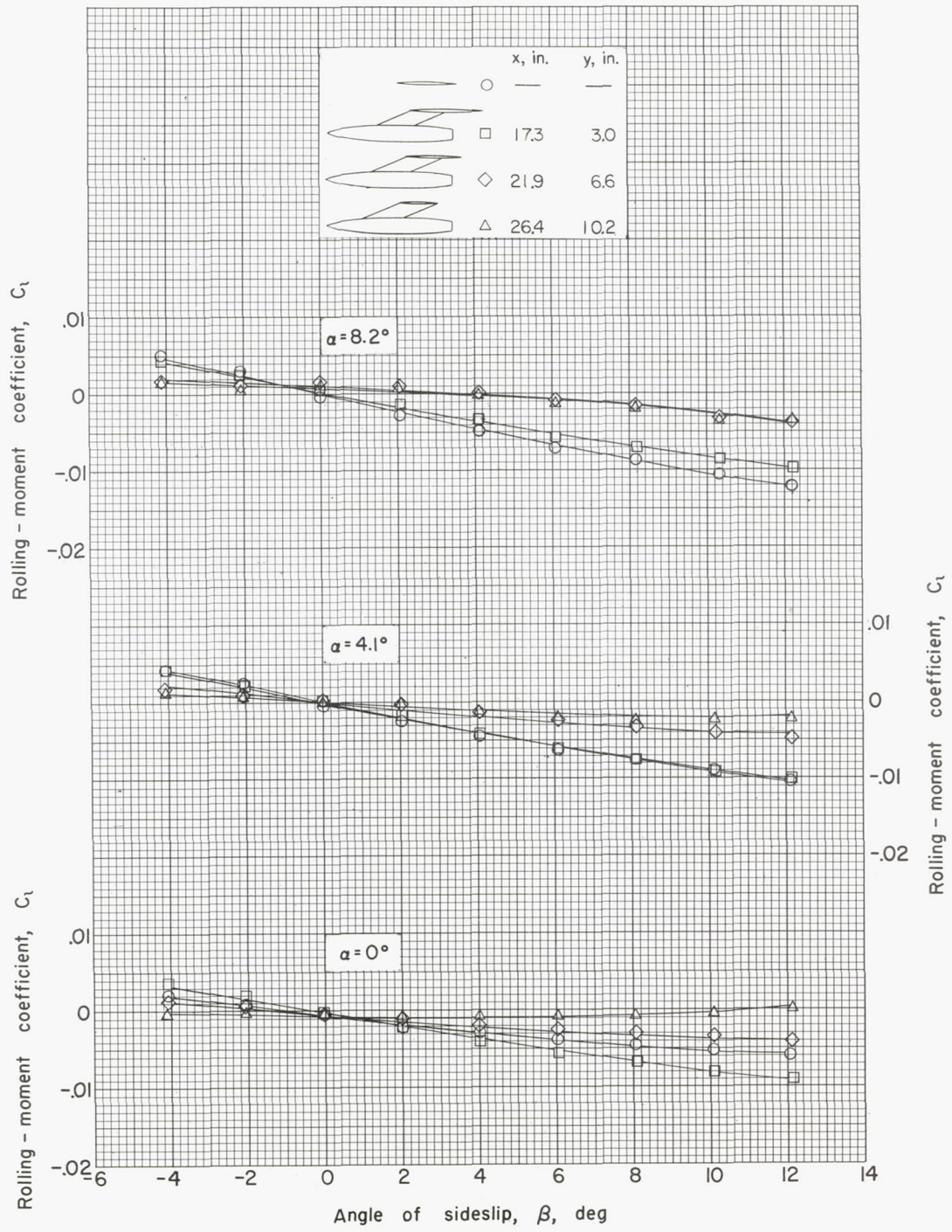
(a) Variation of C_Y with β.

Figure 11.- Lateral characteristics of the wing-fuselage-store-pylon combination for three spanwise store positions.



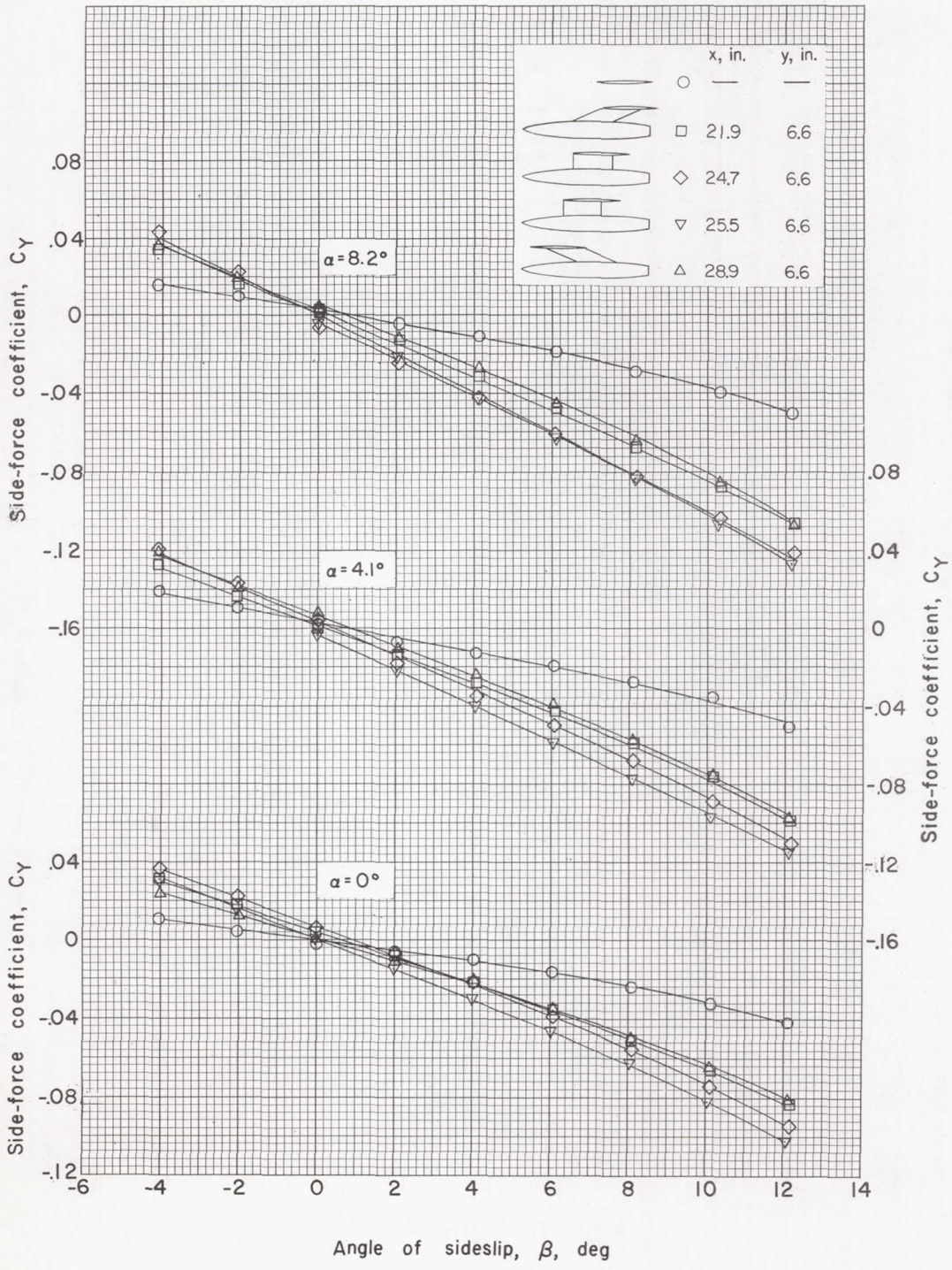
(b) Variation of C_n with β.

Figure 11.- Continued.



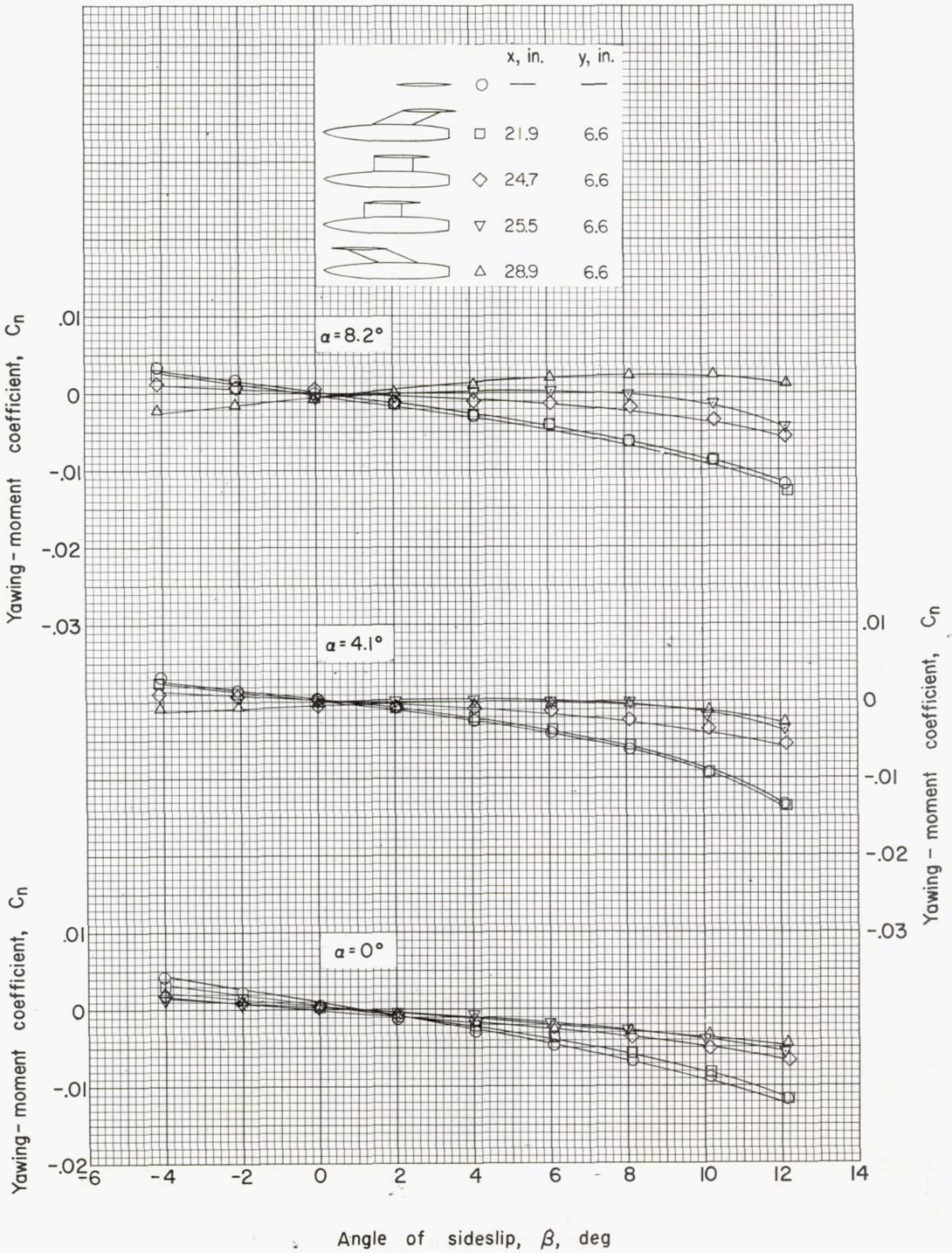
(c) Variation of C_l with β.

Figure 11.- Concluded.



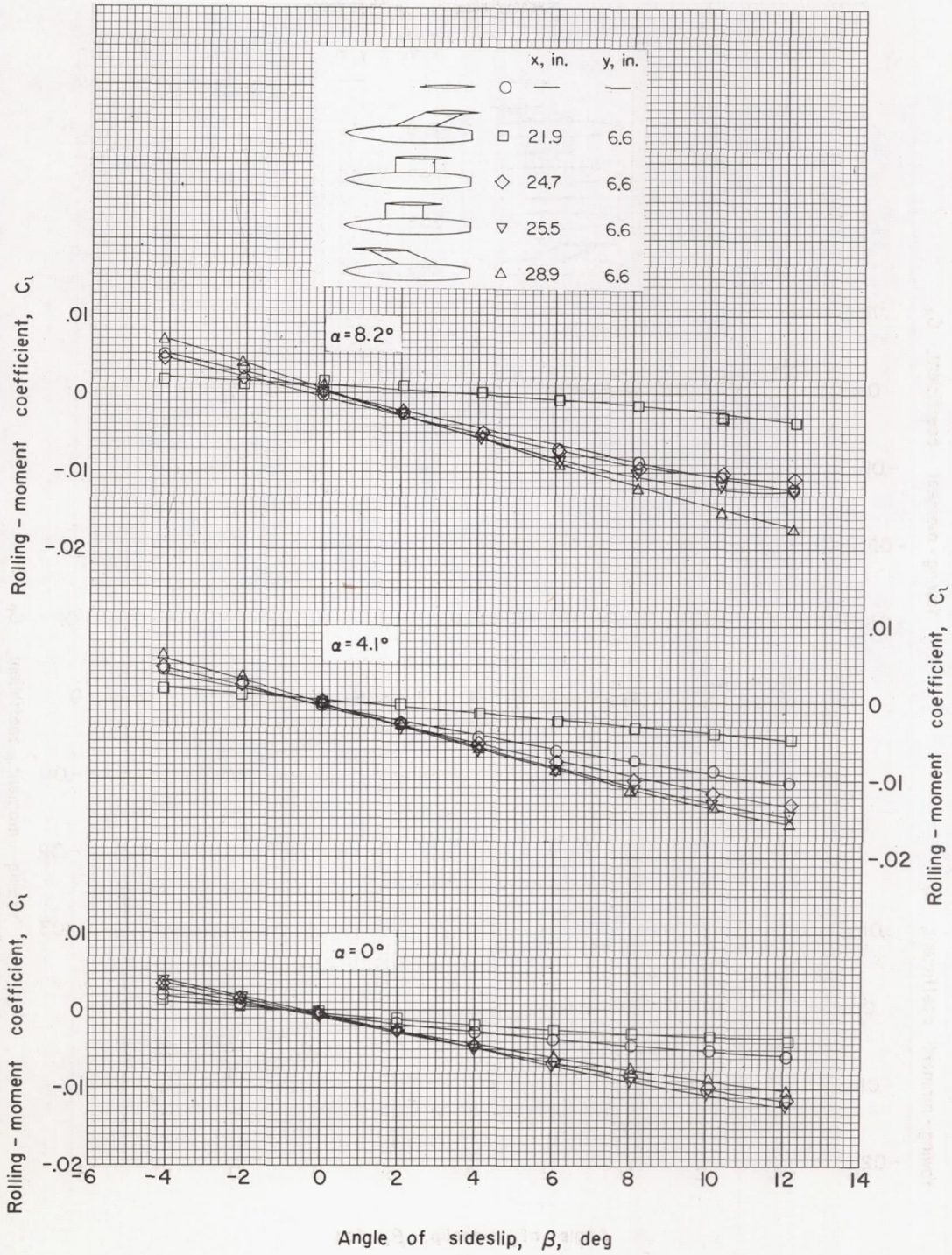
(a) Variation of C_Y with β.

Figure 12.- Lateral characteristics of the wing-fuselage-store-pylon combination for four store chordwise positions.



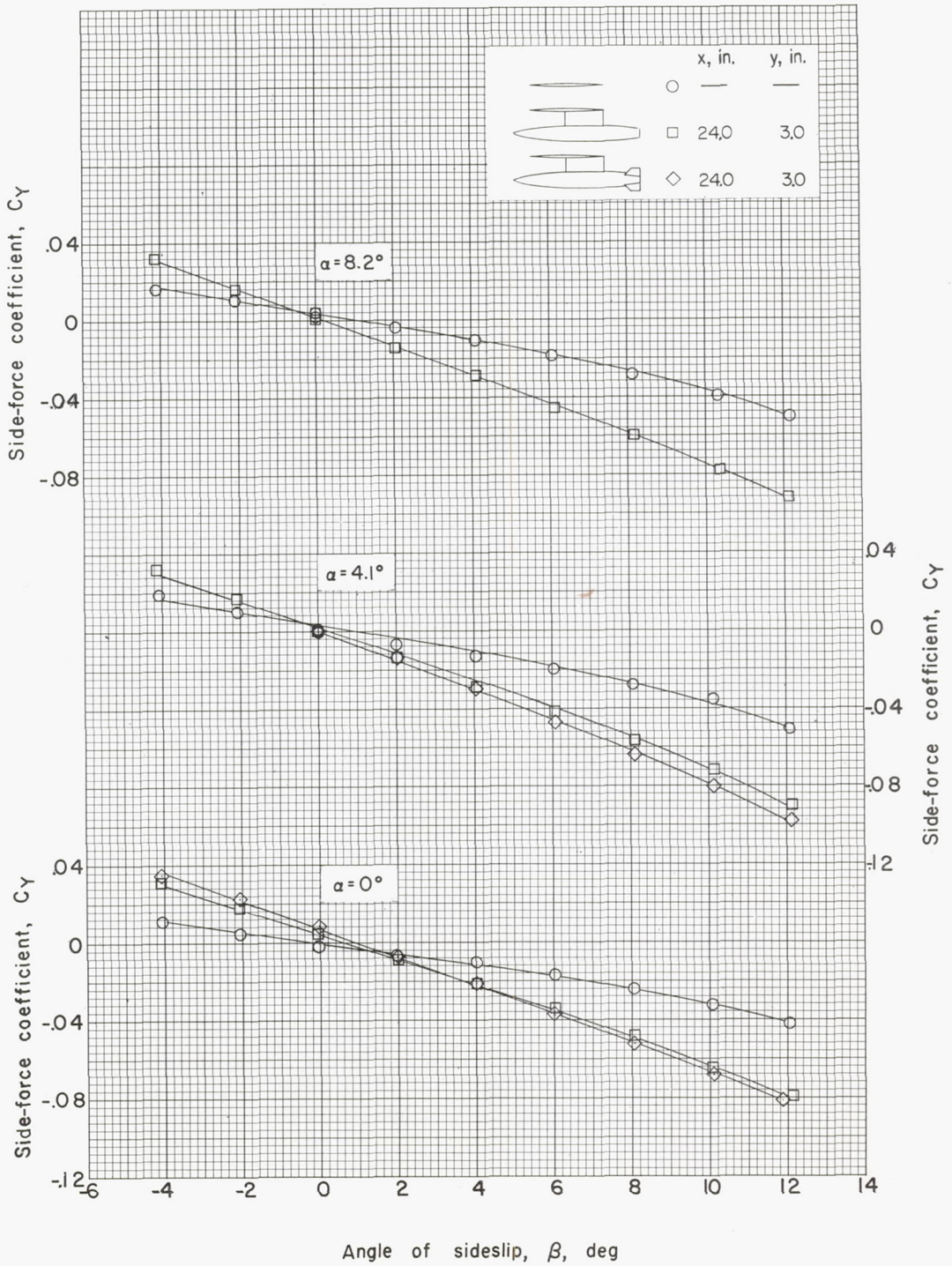
(b) Variation of C_n with β.

Figure 12.- Continued.



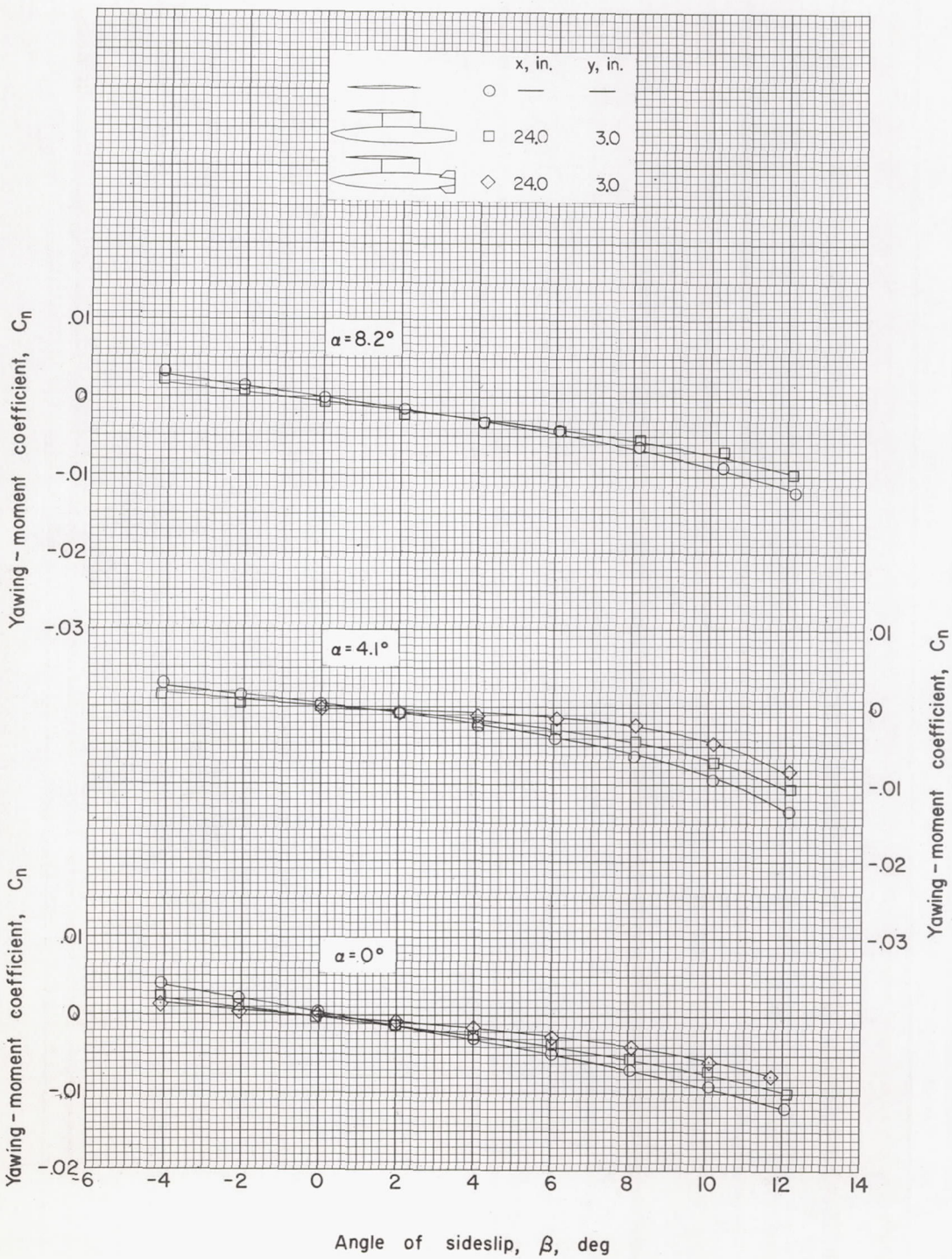
(c) Variation of C_l with β.

Figure 12.- Concluded.



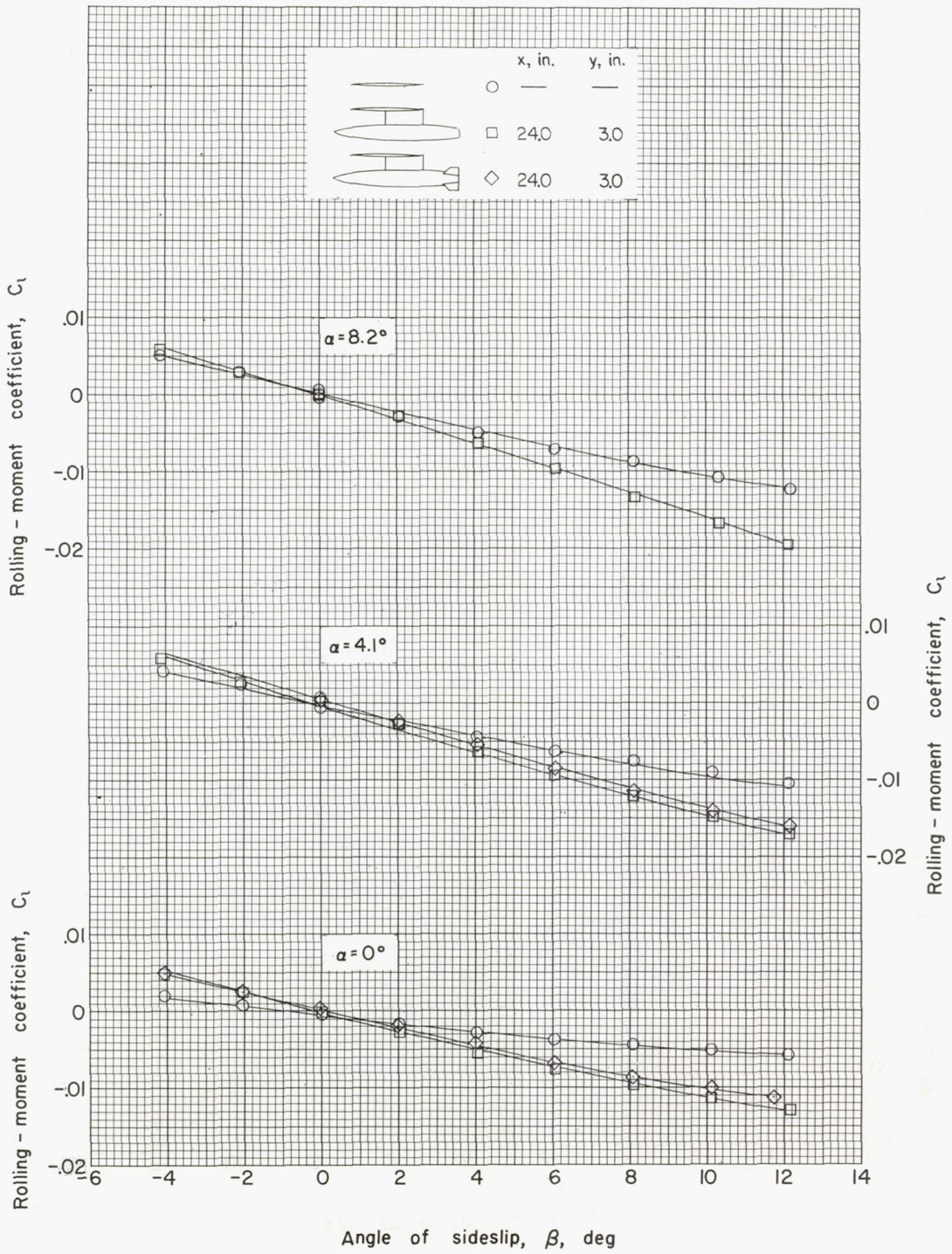
(a) Variation of C_Y with β.

Figure 13.- Lateral characteristics of the wing-fuselage-store-pylon combination with store fins.



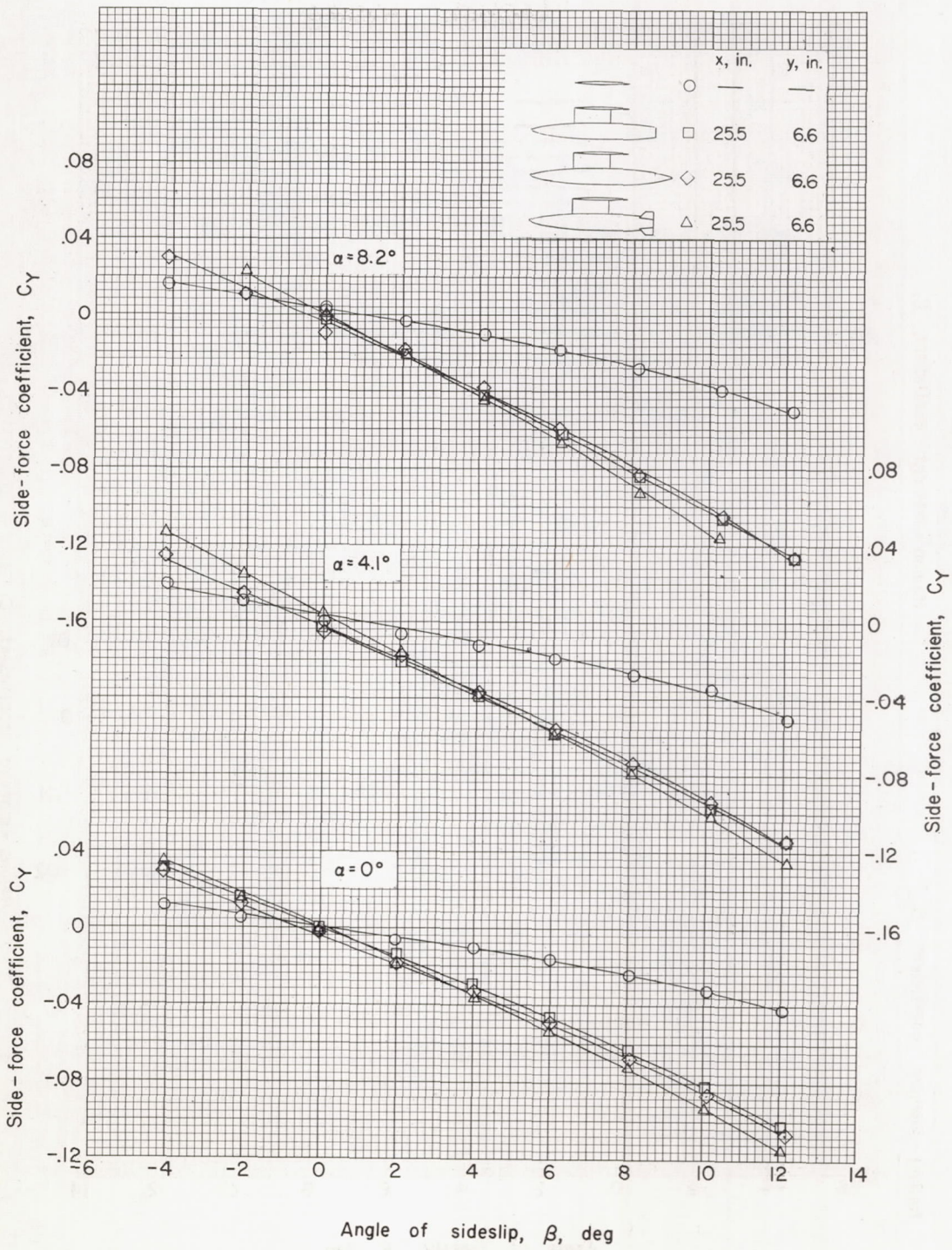
(b) Variation of C_n with β.

Figure 13.- Continued.



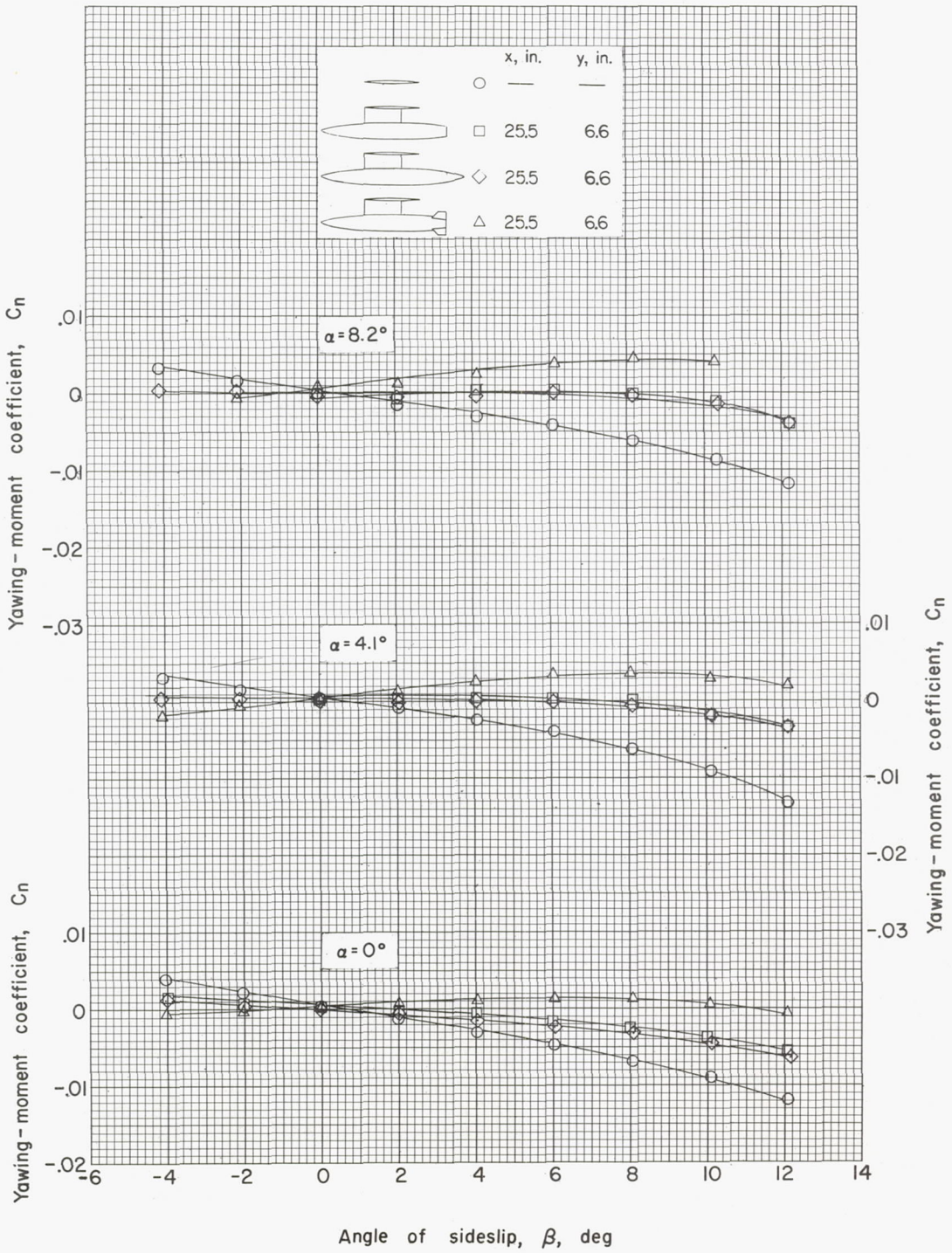
(c) Variation of C_l with β.

Figure 13.- Concluded.



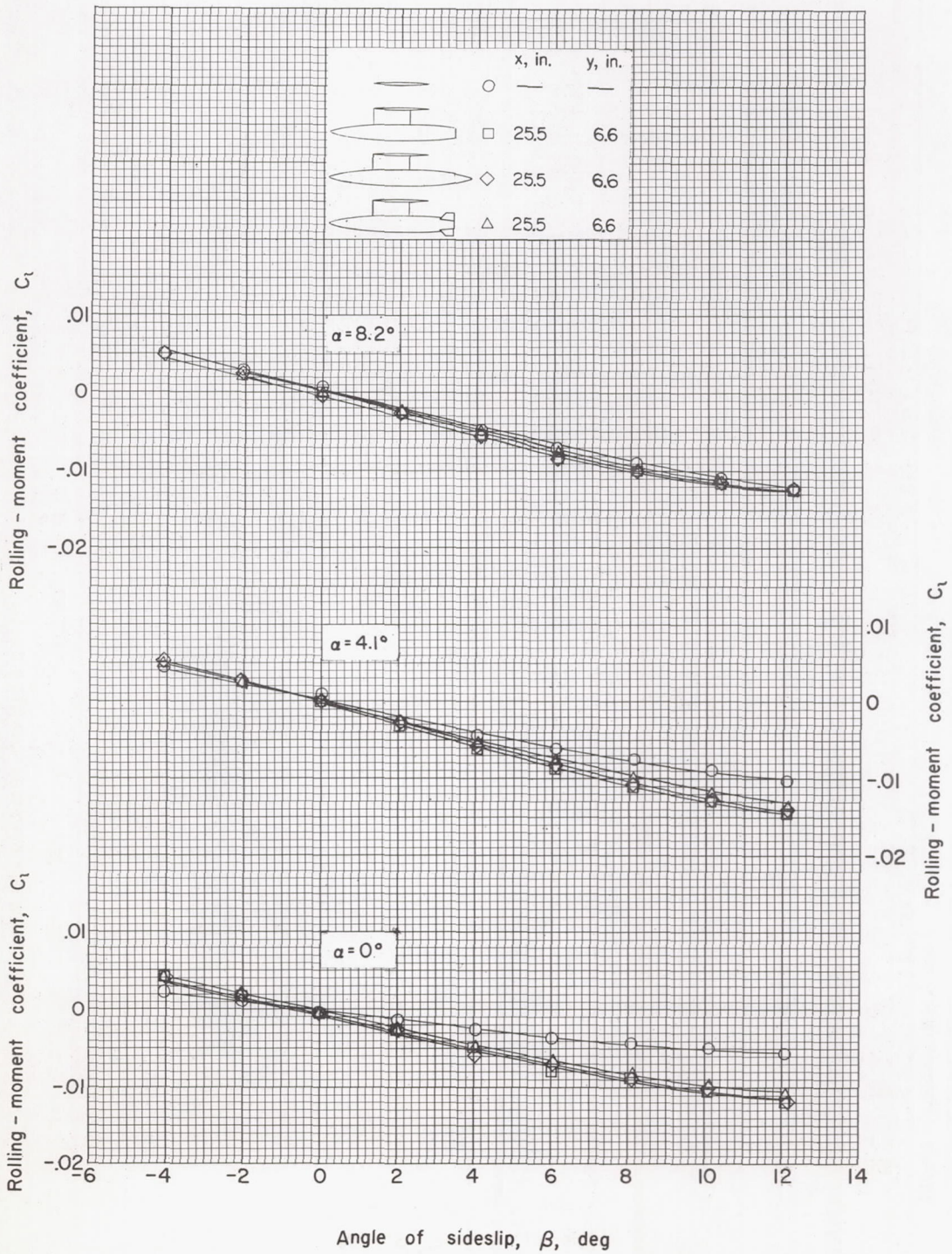
(a) Variation of C_Y with β.

Figure 14.- Lateral characteristics of the wing-fuselage-store-pylon combination with store fins and with store tail cone.



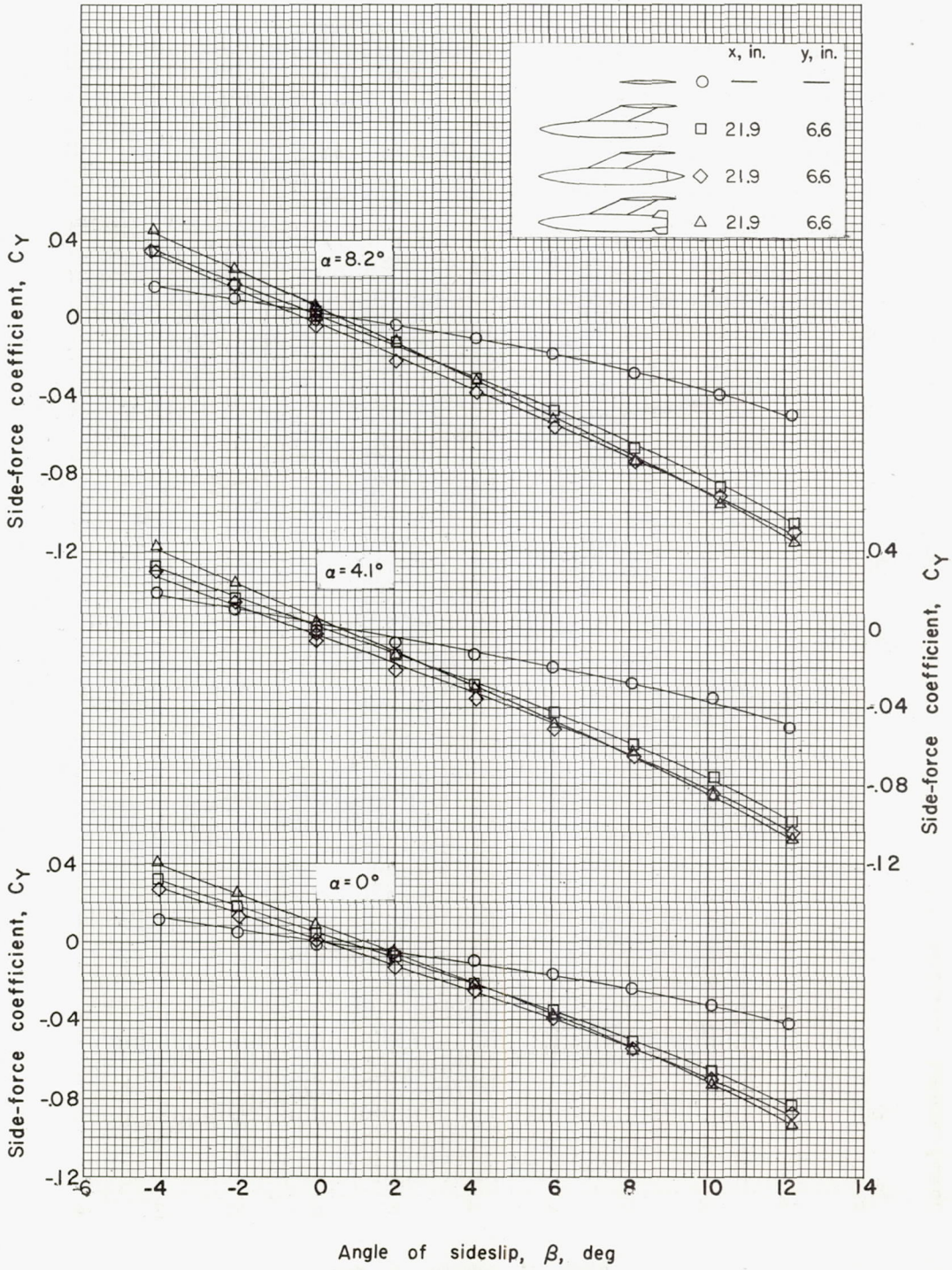
(b) Variation of C_n with β.

Figure 14.- Continued.



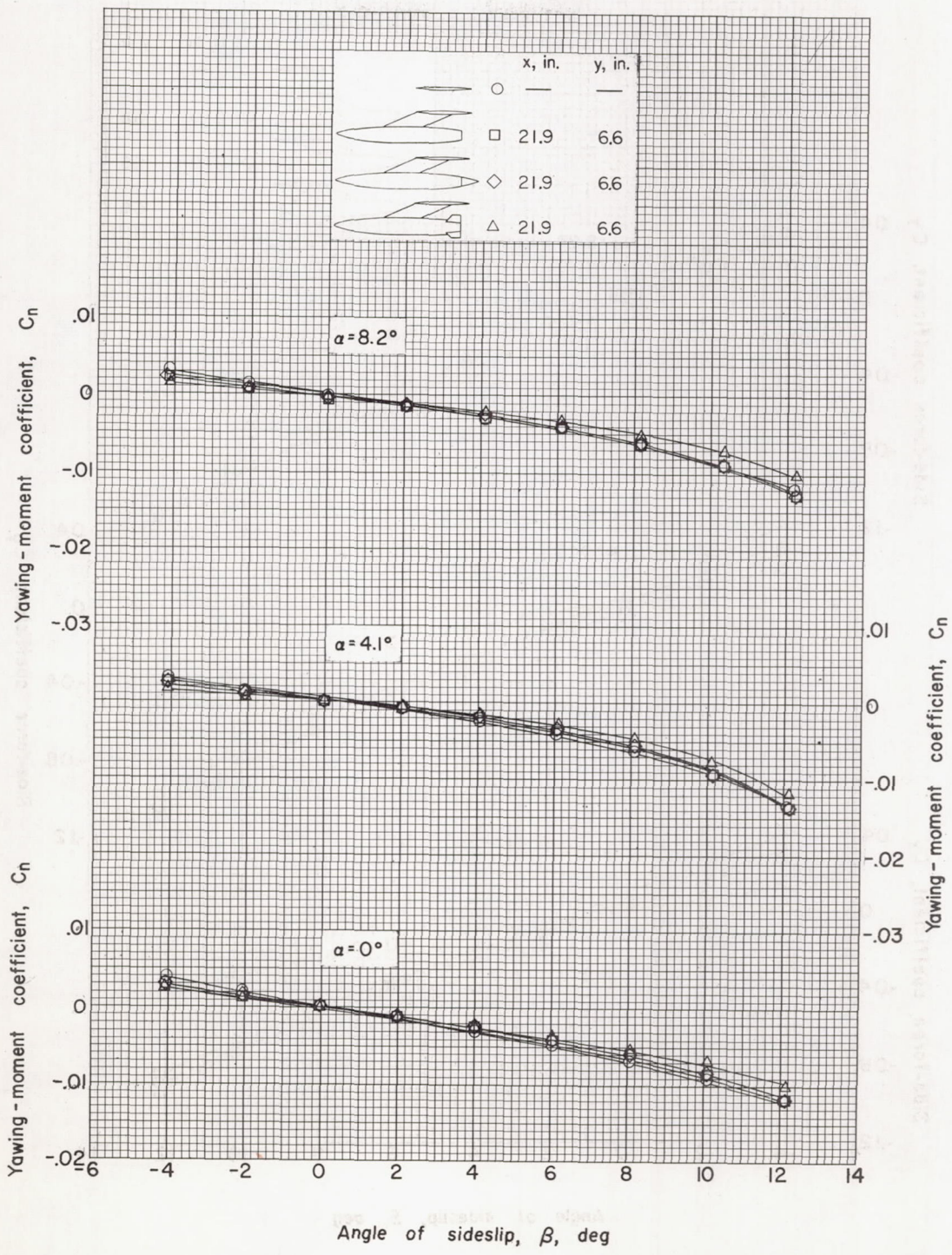
(c) Variation of C_l with β.

Figure 14.- Concluded.



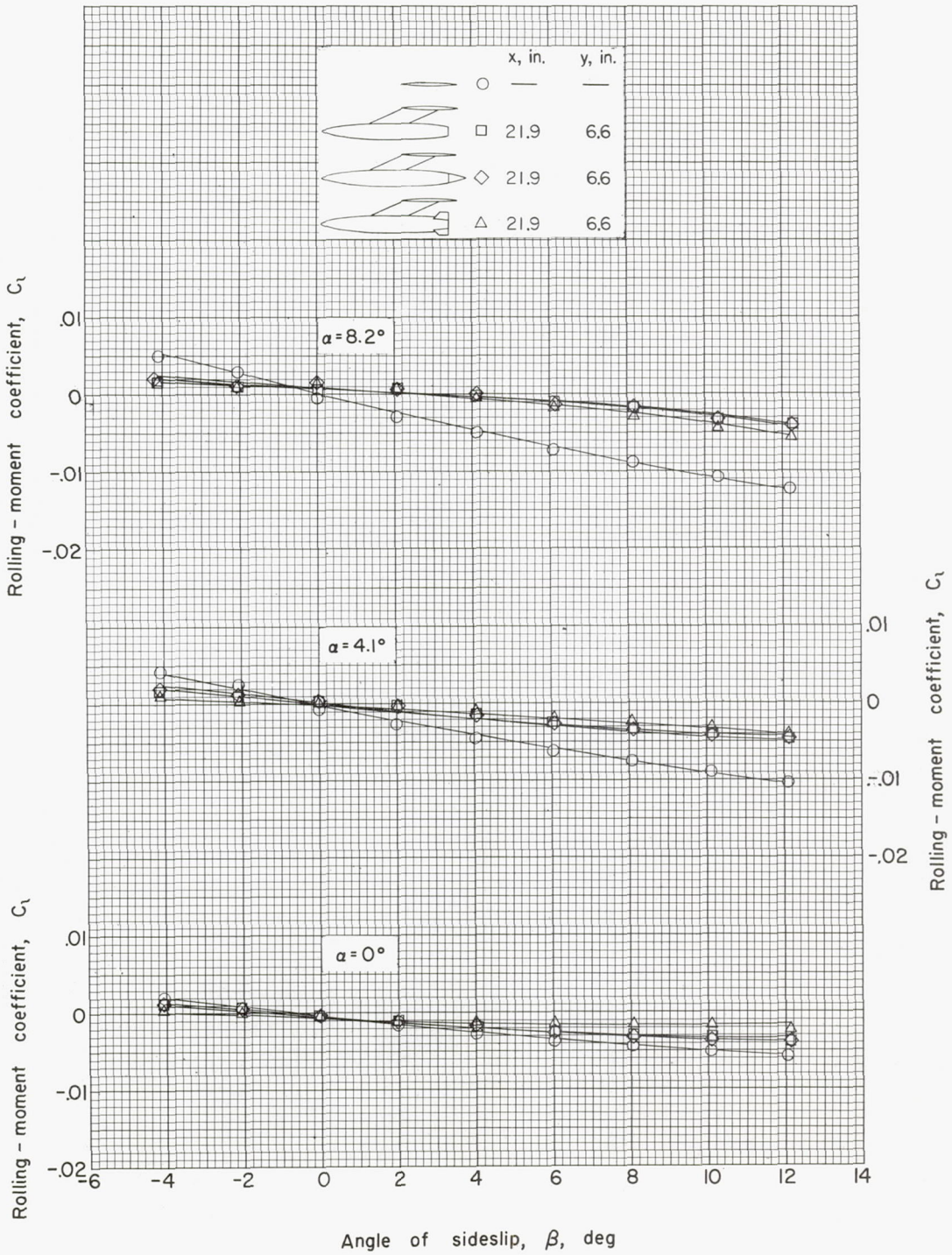
(a) Variation of C_Y with β.

Figure 15.- Lateral characteristics of the wing-fuselage-store-pylon combination with store fins and with store tail cone.



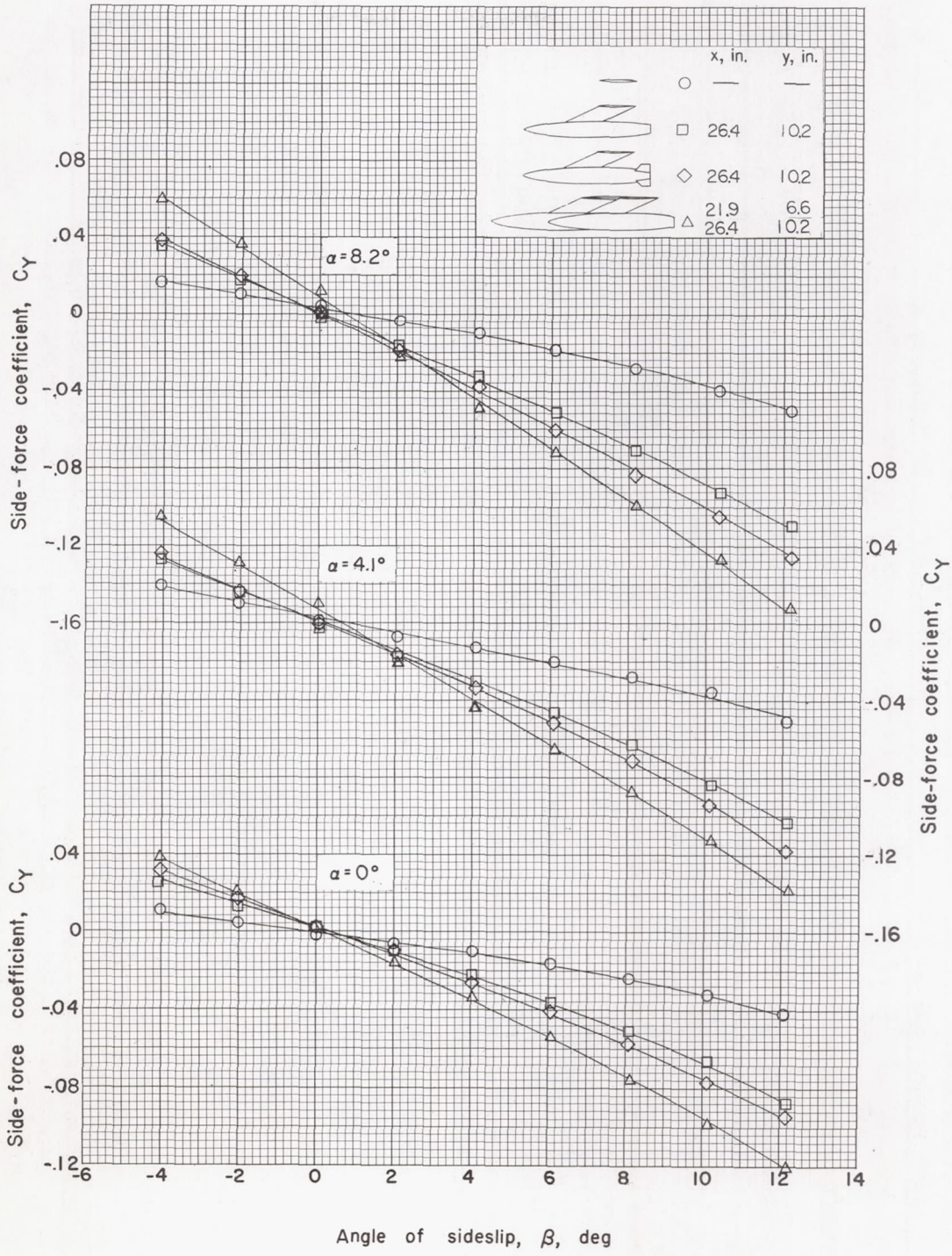
(b) Variation of C_n with β.

Figure 15.- Continued.



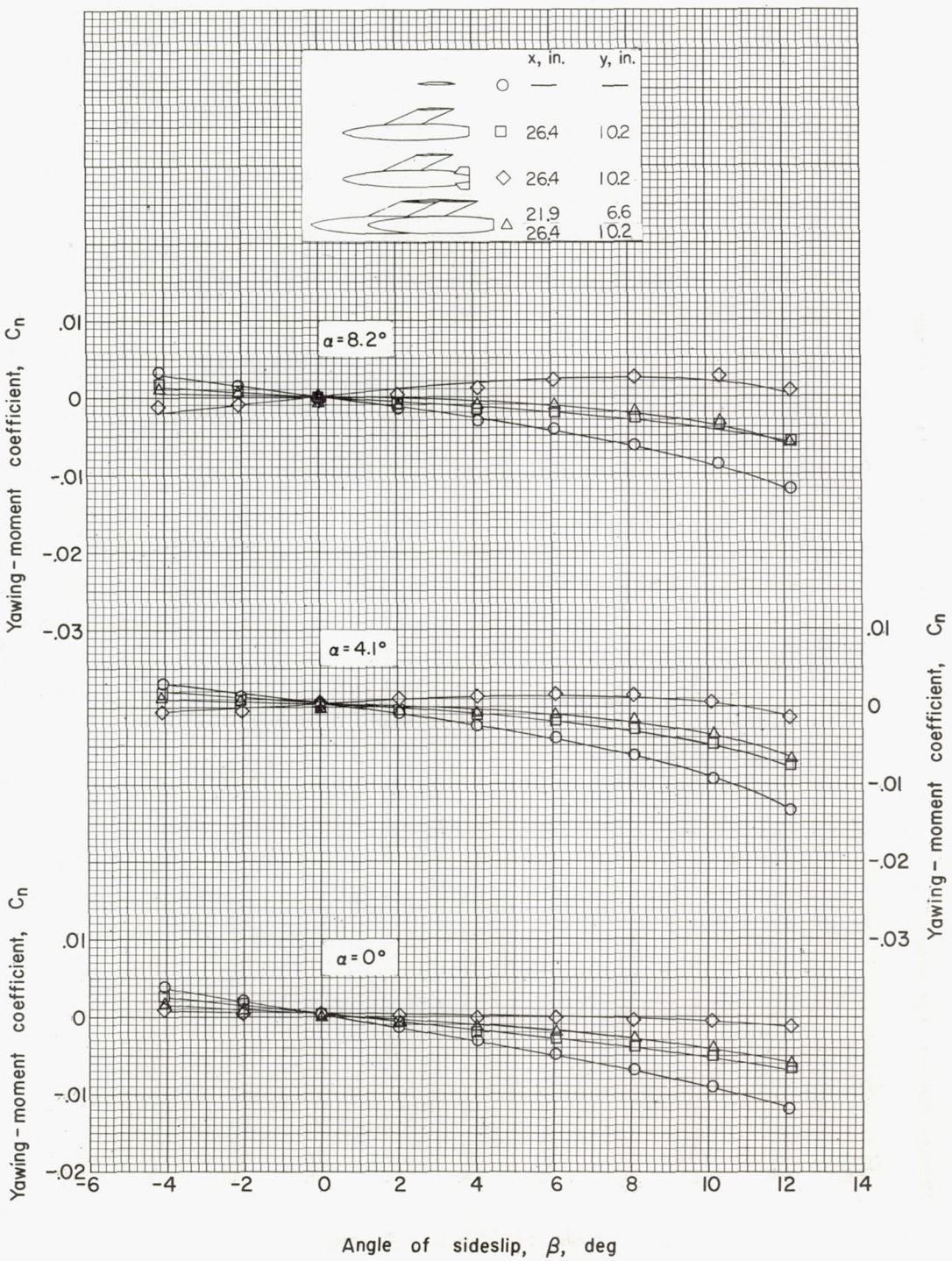
(c) Variation of C_l with β.

Figure 15.- Concluded.



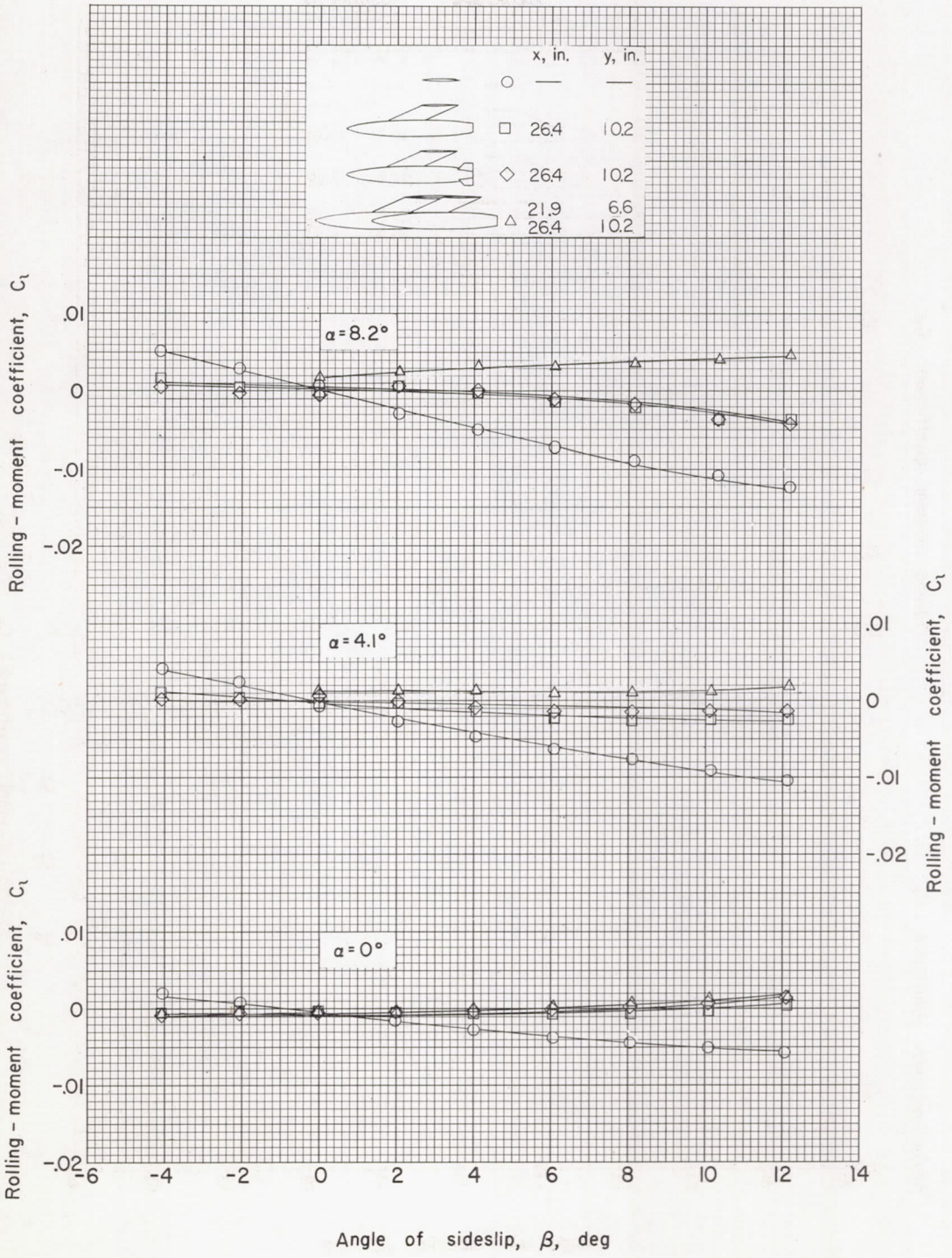
(a) Variation of C_Y with β.

Figure 16.- Lateral characteristics of the wing-fuselage-store-pylon combination with store fins and with double-store installation.



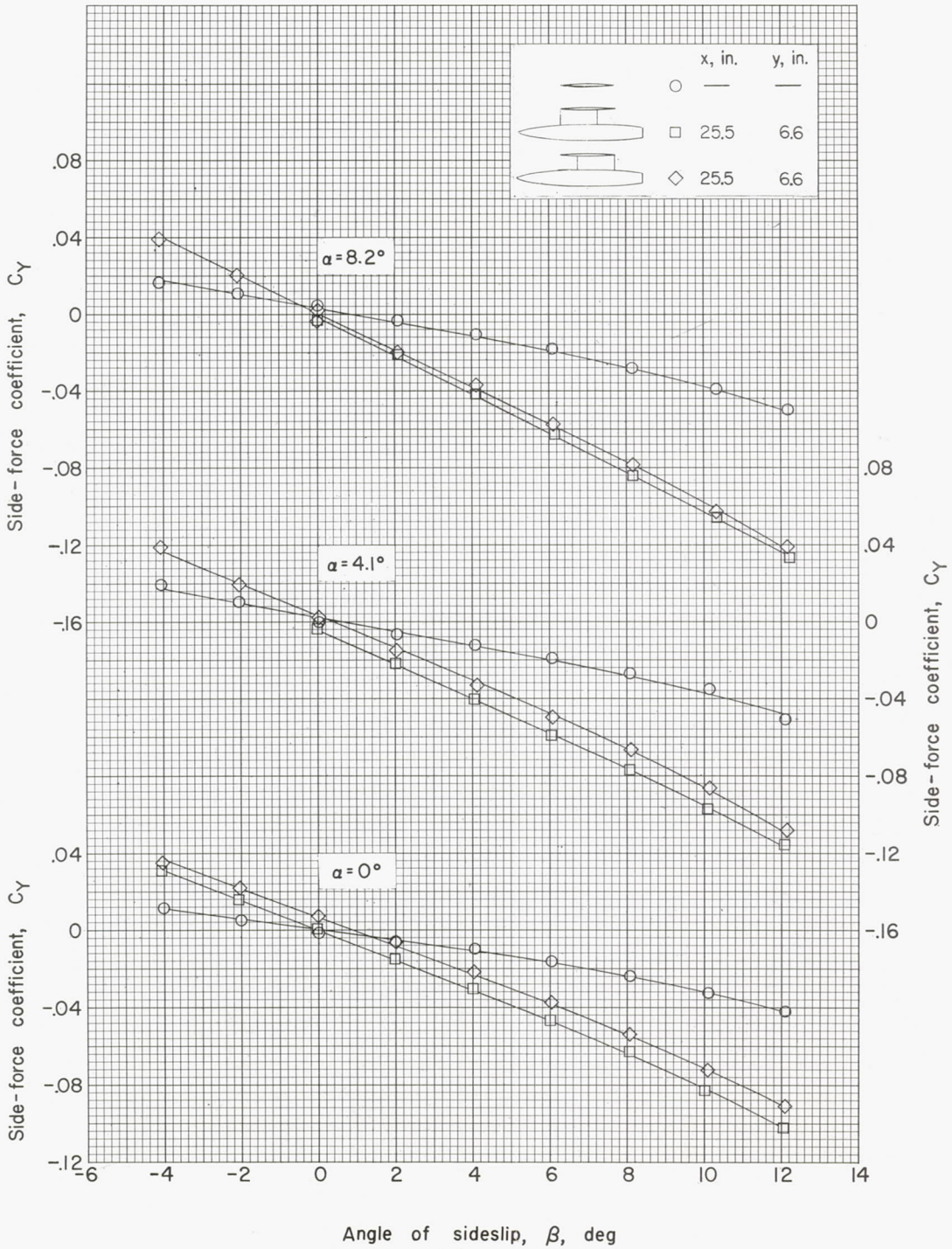
(b) Variation of C_n with β.

Figure 16.- Continued.



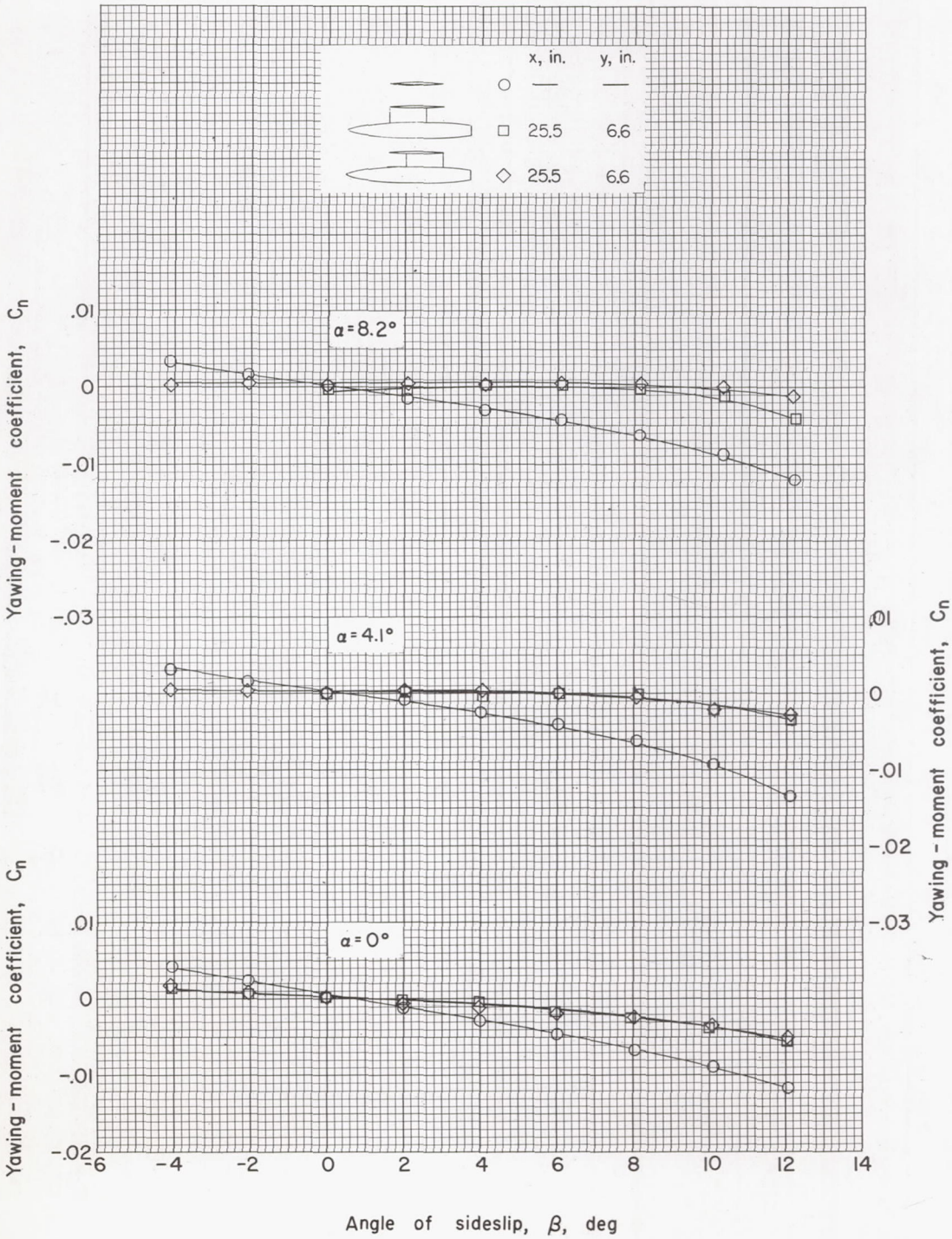
(c) Variation of C_l with β.

Figure 16.- Concluded.



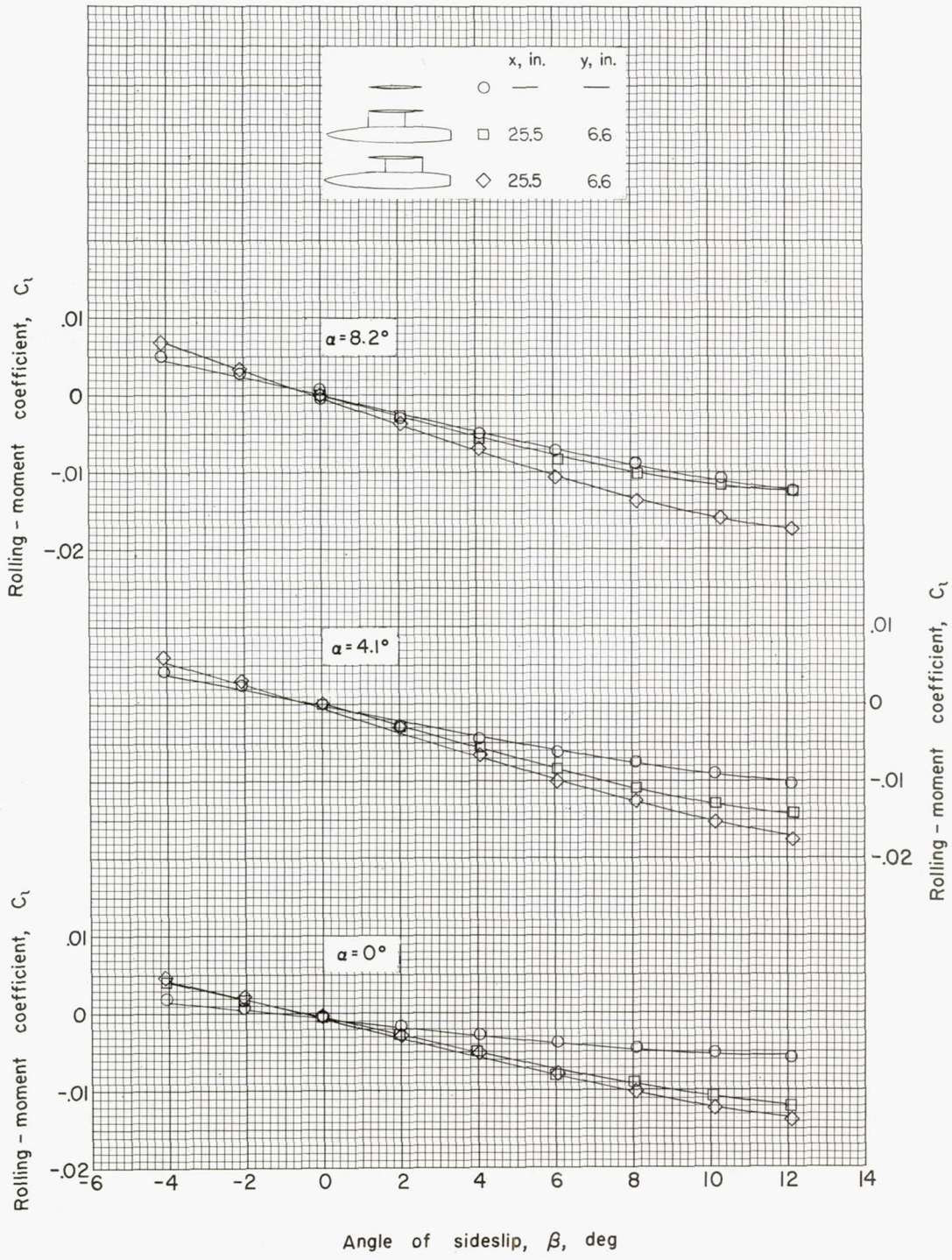
(a) Variation of C_Y with β.

Figure 17.- Lateral characteristics of the wing-fuselage-store-pylon combination for a forward and rearward pylon location.



(b) Variation of C_n with β.

Figure 17.- Continued.



(c) Variation of C_l with β.

Figure 17.- Concluded.

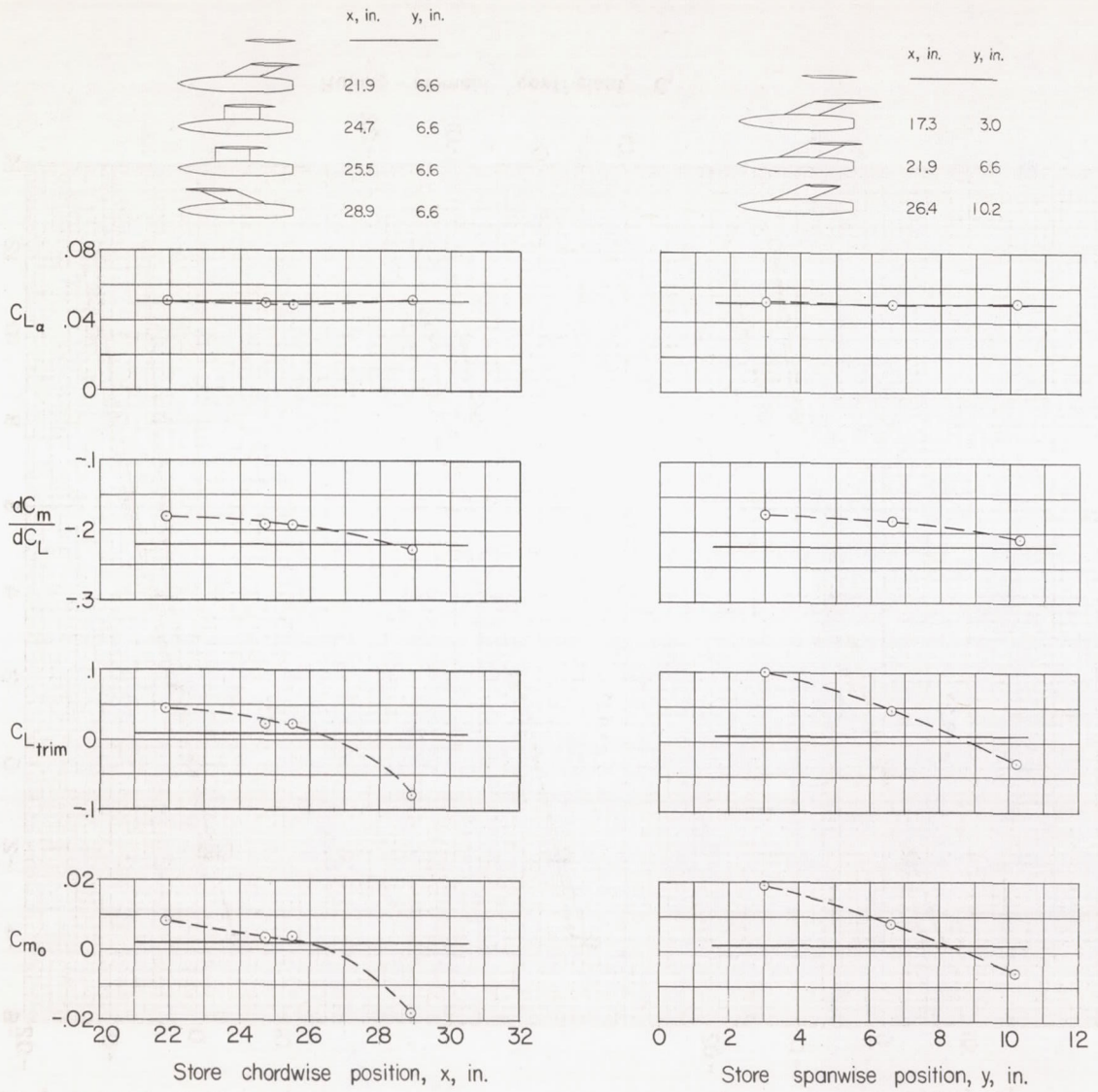


Figure 18.- Effect of spanwise and chordwise store position on the longitudinal characteristics of the wing-fuselage-store-pylon combination.

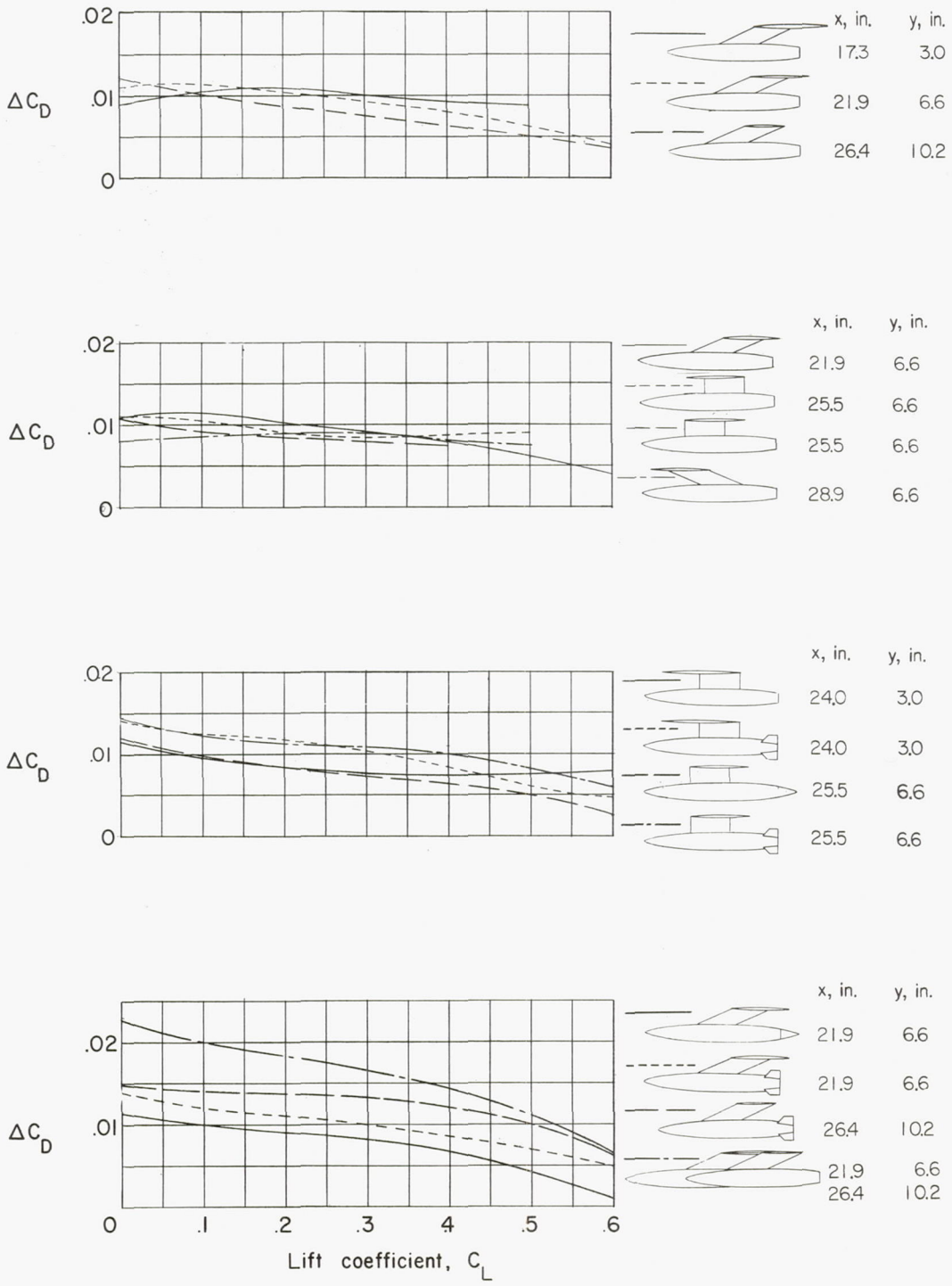
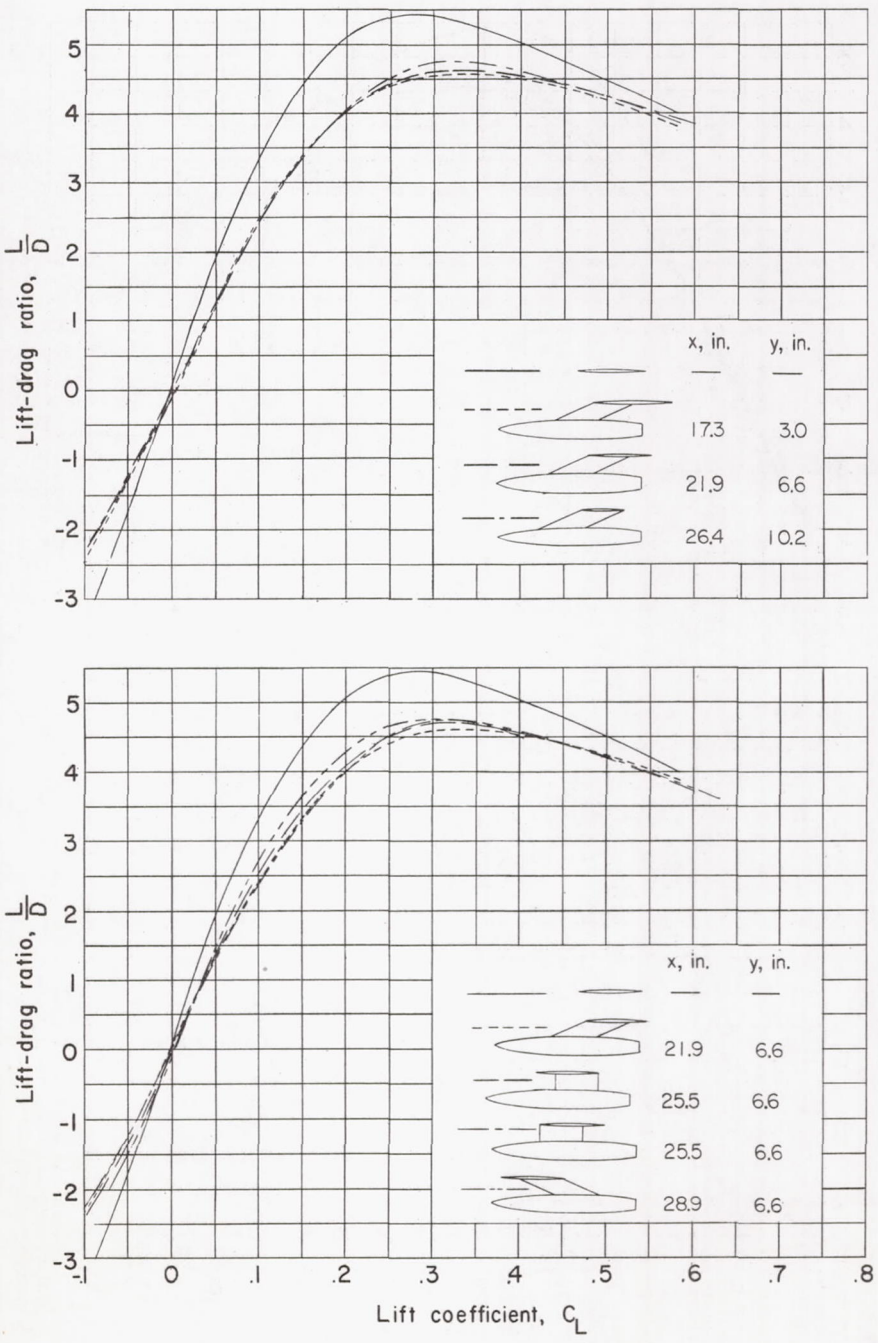
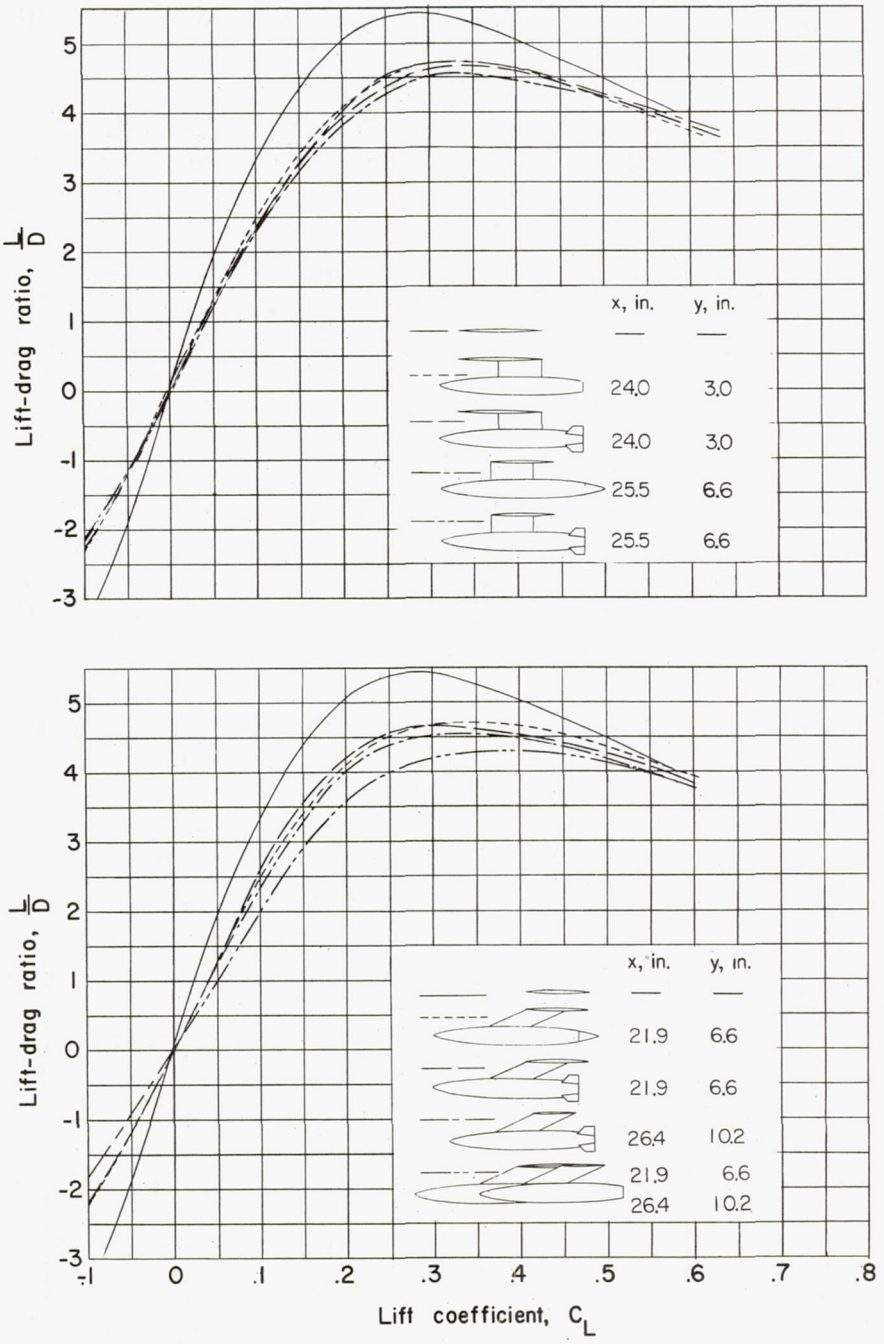


Figure 19.- Incremental drag of the complete model configuration resulting from the various store-pylon installations.



(a) Spanwise and chordwise store positions.

Figure 20.- Effect of the various store-pylon installations on the lift-drag ratios.



(b) Store with fins, with tail cone, and double-store installation.

Figure 20.- Concluded.

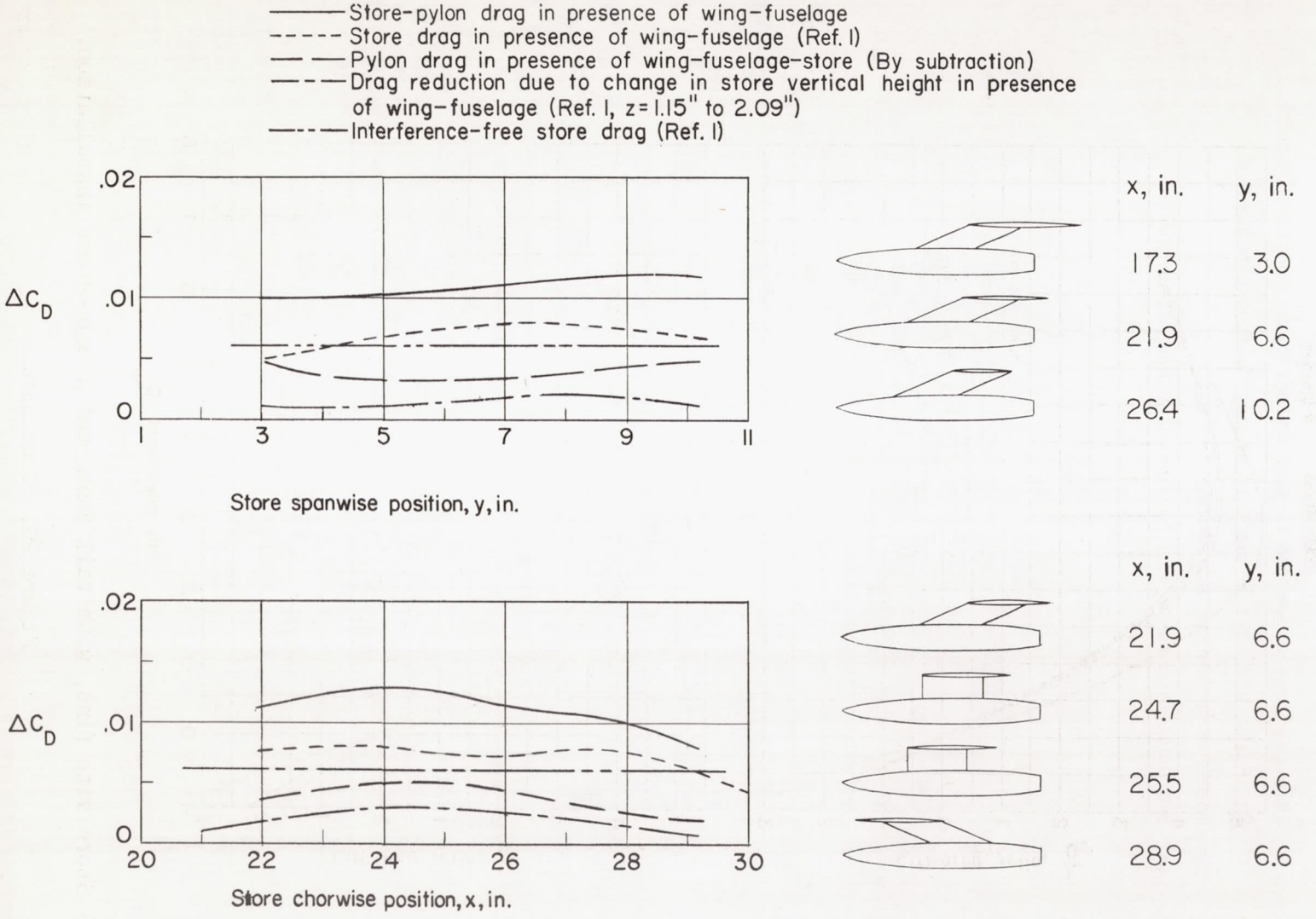


Figure 21.- Effect of store-pylon combination on wing-fuselage drag. $\alpha = 0^{\circ}$.

○ Store side force in presence of wing-fuselage-pylon combination (Ref. 5)

□ Store-pylon side force in presence of wing-fuselage combination (Ref. 5)

◇ Isolated wing-fuselage side force

△ Side force of complete wing-fuselage-store-pylon combination

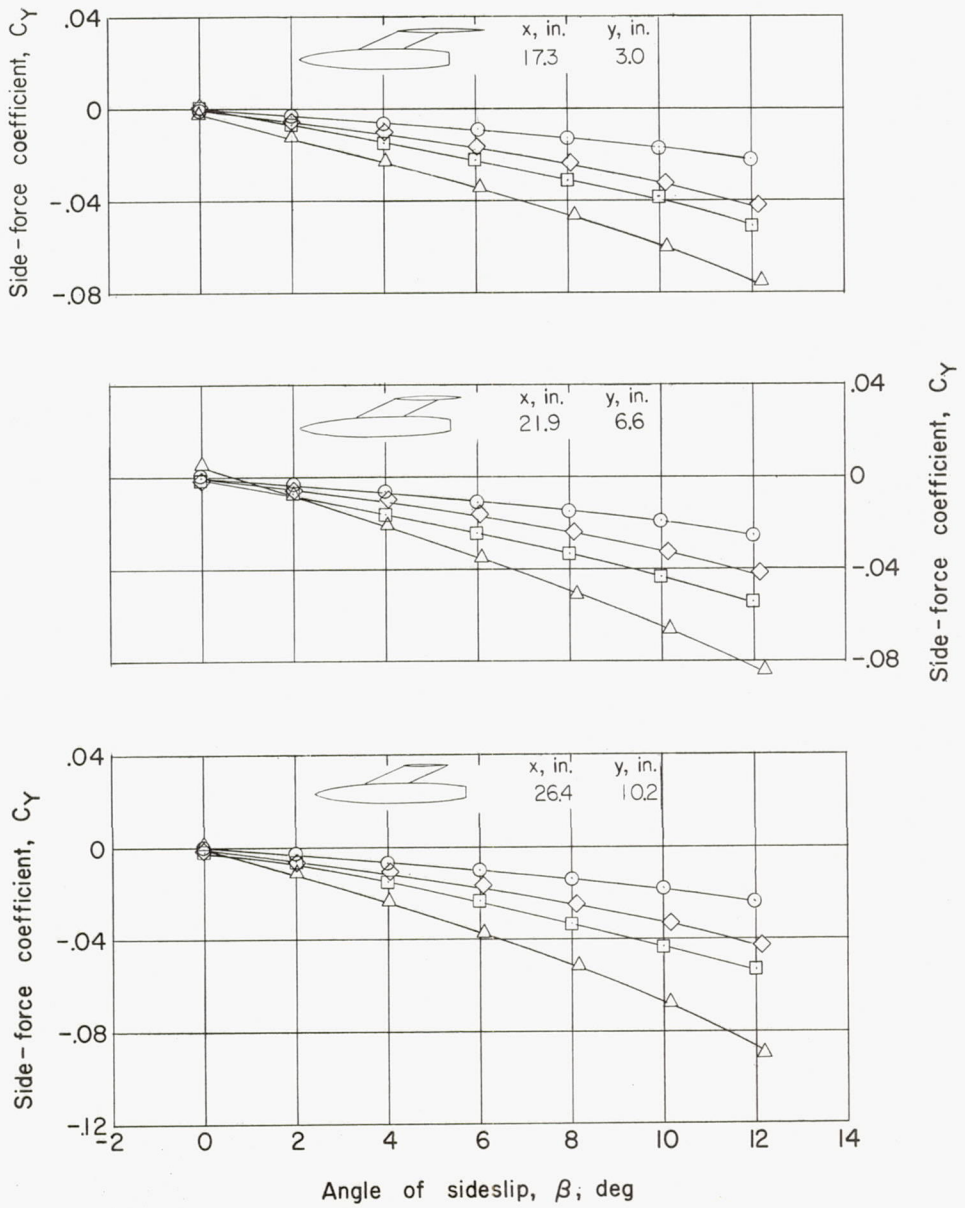


Figure 22.- Relative contribution of the store-pylon side force toward total side force for three spanwise store positions. $\alpha = 0^\circ$.

NACA - Langley Field, Va.